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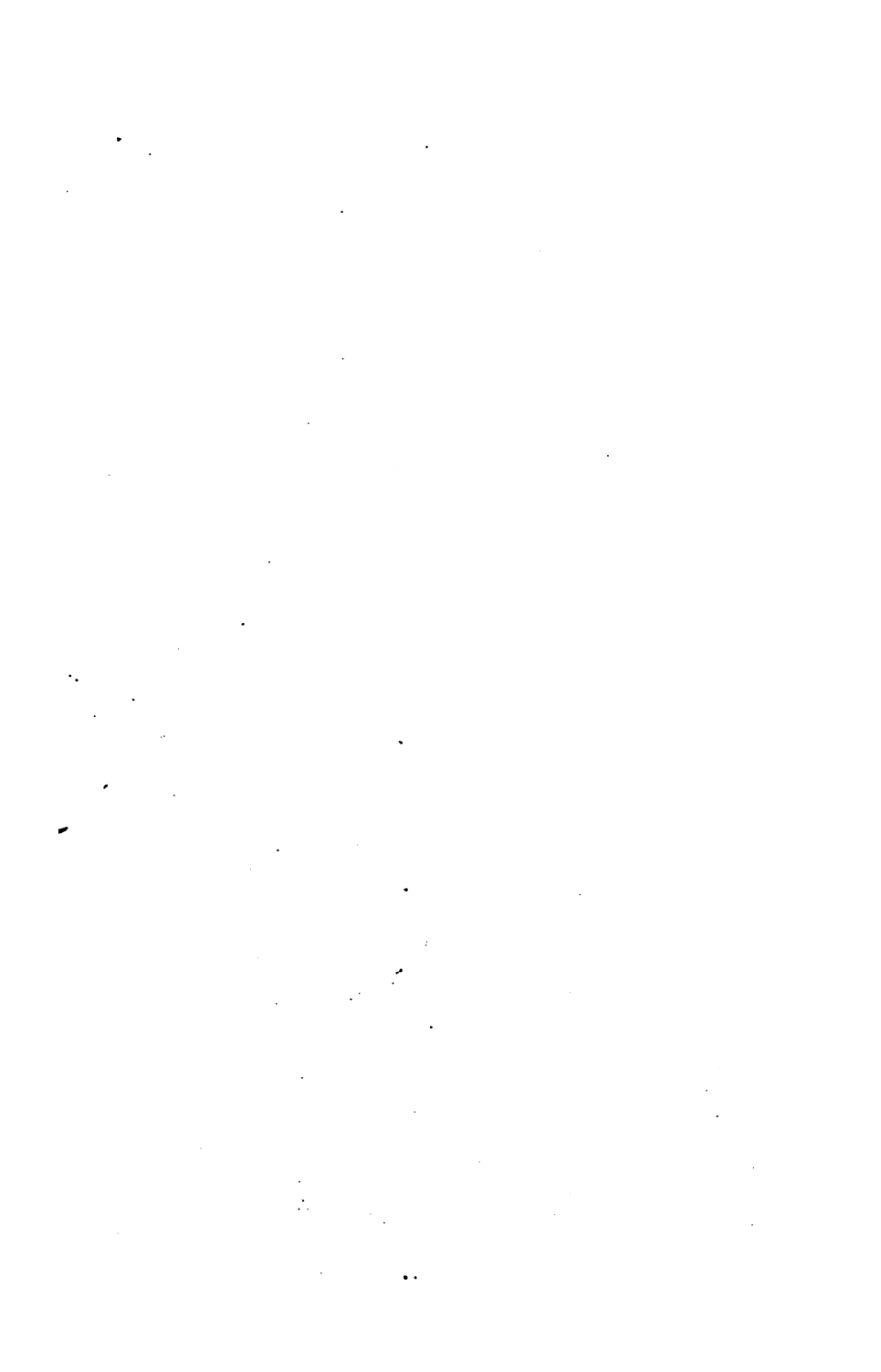
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THE
CAUSES AND TREATMENT
OF
LATERAL CURVATURE OF THE
SPINE



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CAUSES AND TREATMENT
OF
LATERAL CURVATURE OF
THE SPINE.

BY RICHARD BARWELL, F.R.C.S.,
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PREFACE.



THIS work, the first edition of which appeared in 1868, has now been, for the following reasons, entirely rewritten: that and the two subsequent editions, besides dealing with certain points as to the normal mobility of the spine and the causality of its morbid curves, inculcated methods of treatment less injurious and irksome, and at the same time more efficacious than the "supports," &c., which were then almost exclusively employed. In the present volume the same principles are advocated as to the use and construction of elastic appliances, which in some instances, however, are a little modified in form. The third edition was published in 1878; in the interval that has since elapsed, I have taken, in regard to certain points, an entirely new departure, of which it seems desirable that a few words accounting for its development should be said, and giving it, if I may use such term, a formal introduction to the reader.

Probably every one who has had anything to do

with the treatment of scoliosis, of necessity a gradual process, must have been troubled with the difficulty of ascertaining with accuracy, improvement or the reverse, still more, of computing the amount of either. Yet a reliable means of doing so is essential—scientifically, because without it we cannot *know*—practically, because a surgeon in full work cannot possibly remember, after several days, the exact aspect of many backs. His views, as the progress of the case is therefore founded upon mere impression, perhaps quite opposed to that of the patient herself or of her relatives. I determined, therefore, to devise an instrument giving easily interpreted indications in language so untechnical that any lady could understand it. The result of my endeavours is the "scoliosis gauge," described in Chapter VI. which gives rapid and concise measures of all deviations and malpostures. The use of this instrument pointed out to me at once a previously undetected abnormality, which I have described under the name of amesial pelvis.

The next point is an important addition to treatment, the motive to which was this: very soon after the third edition was printed a fortuitous sequence of severe cases occurred, both in my public and private practice, many of which had been years under different sorts of treatment. For those who had, as also, for those who had not been

thus circumstanced, I was well aware that no benefit could be obtained by loading their backs and shoulders with from four to six pounds weight of metal; while fatiguing them with ineffectual gymnastics and suspensions would only add to the trouble, already sufficient, of their lives. My elastic bandages designed to produce changes in the posture of loins and chest, I found to be most valuable in all moderate degrees of deformity; yet, in the more severe, their action, though always beneficial, was somewhat slow; while in the most advanced forms I always had to tell my patients that I could only produce a relatively small amelioration combined with considerable increase of comfort. With this I could not, however, rest content, and certain cases, very refractory to every method that had been employed, induced me to consider and then very carefully to try some means of applying force to rectify the two chief aberrations, rotation and lateral deviation. My efforts culminated in that which is described in the text as "*rachilysis*," a name adopted because both morbid anatomy and clinical experience teach me that, in all but the latter phases of the third stage, shortening of the ligaments, a condition we frequently treat in the limbs with success, is, in by far the larger number of cases, the fault most necessary to be overcome: Loosening of the spine—that is setting the *vertebræ*

free to accept the influence of a slighter and persuasive force—has been in my hands remarkably efficacious. Certain cases at the end of the volume attest this with such force that I might hesitate to publish them ; but the records are made not by me, but by the gauge, I being only the amanuensis. Some of my patients' relatives watch the index, write and keep their own notes, and two of the cases referred to (Cases XIII. and XIV.) were thus doubly recorded ; before printing them our separate registers were compared.

Having thus called attention to what is chiefly new in this fresh edition of the work, it seems that the aim and object of a Preface, not it is hoped too long, has been fulfilled.

RICHARD BARWELL,
55, WIMPOLE STREET.

May, 1889.

CONTENTS.

CHAPTER I.

PHYSIOLOGY AND ACTIONS OF THE SPINE.

Physiology and actions of the spine—Mature and immatur
vertebræ—Ligaments of the spine—Their physiological
differences—Normal curves—Mobility of spine—Lateral
flexibility—Undulations—Extent of rotation—Great Ser-
ratus—Bell's theory, and denials of—Relations between
lateral flexion and rotation Page 1

CHAPTER II.

DEFINITIONS AND DESCRIPTIONS.

Lateral curvature defined—Congenital and acquired curves—
Composed of lateral deviation and rotation—Kinds of
curve—Sex—Age and direction—Really a spiral—Amounts
of rotation—First stage—A posture—Second stage—
Muscular and ligamentous shortening—Third stage—
Bony changes—Changes in vertebral bodies—In process
—They show that vertebræ are rotated by the ribs—
Changes in position and form of ribs—Scoliotic skeleton—
Changes in shape of thorax—Visceral displacement .. 30

CHAPTER III.

PROGNOSIS AND HEREDITY.

Various rates of progress—Relapses—Causes of—Rickets—
Prognosis in different stages—Question of heredity—
Question of marriage—Deleterious effect of rapid child-
bearing—On the mother—On the later children. .. 60

CONTENTS.

CHAPTER IV.

CAUSES OF PRIMARY LUMBAR CURVATURE.

Permanent obliquity of pelvis—Its many causes—Mode in which it influences the spine—Habitual obliquity of pelvis—The amesial pelvis—Bad positions in writing—Curves from rheumatism—Renal diseases—Ovaralgia Page 71

CHAPTER V.

CAUSE OF DORSAL CURVE.

Difficulties of investigation—Sabatier's physiological curve—Views of Bouvier Volkmann—Adams—Struthers—Author's explanation—Three periods of curvature—Infantile curvature—Writer's curvature—Volkmann's views—Schenk's statistics—Author's description—How produced—Rotation first change—Amesial pelvis—Weight-bearing curve—Pulmonary curve 87

CHAPTER VI.

THE AUTHOR'S SCOLIOSIS GAUGE.

The many previous attempts at measuring—The strip of lead—Heinecke's pendulum and staff—Mickulicz Scolio-meter—Shulthess's drawing-machine—The scoliometer measures—Pelvic obliquity and amesiality—Spinal rotation and deviation—Records for taking notes 118

CHAPTER VII.

DIAGNOSIS OF LUMBAR CURVES.

Way to examine spine—What to look at and for—Side outline of figure asymmetrical—On dorsal surface—How to find pelvic obliquity—Signs of rotation and of lateral deviation—Diagnosis by the scoliosis gauge 129

CONTENTS.

xi

CHAPTER VIII.

DIAGNOSIS OF RIGHT DORSAL CURVATURE.

The thick and high shoulder—Bird's-eye view of back—
Sessile right and pedunculated left arm—Side outlines—
Posture of arms lower down and amesial pelvis—Surface
of back—The "hump" of lateral curve—The thick root of
neck Page 141

CHAPTER IX.

CERTAIN PREVALENT MODES OF TREATMENT.

The orthopædic support—Its defects and inefficiency—
Poro-plastic jacket and plaister of Paris jacket—Lorenz—
Three forms of plaister of Paris bandages—His methodical
redressement—Gymnastics 157

CHAPTER X.

THE TREATMENT OF LUMBAR CURVATURE.

For young very flexible spines—Very simple treatment—
Changes of balance—Higher shoe—Sloping seat—Their
mode of action—The lumbar bandage—Lumbar rachilysis
—Rachylitic exercise—Discontinue bad postures in aids
to this 169

CHAPTER XI.

THE TREATMENT OF DORSAL CURVE.

Necessity and modes of rest—Shoulder exercise and shoulder
sling for weight-bearing curve—Advantages of leaning and
of easy attitudes—Ring exercise—Lateral wedge and
lateral extension for amesial pelvis—Respiratory exercise
—Lateral sling—Dorsal rachilysis—The dorso-lumbar
bandage—The rotation bandage 188

CHAPTER XII.**MANAGEMENT OF EXAGGERATED CURVATURE.**

In relapsed cases, and in advanced years—Avoidance of fatigue and stringent appliances—Management of intercostal and neuralgic pain—The side-bandage—Occasional improvement Page 227

LIST OF ILLUSTRATIONS.

FIG.	PAGE
1.—Ossifying vertebral body with epiphysal plates ..	2
2.—Lateral flexibility of the spine	9
3.—Diagram of rotation	11
4.—Rotation action of serratus magnus	22
5.—Diagram of spinal twist and rotation	37
6.—Diagram of rotation planes	39
7.—Front view of scoliotic vertebræ	46
8.—A scoliotic dorsal vertebra from above	50
9.—Scoliotic skeleton	53
10.—The 5th thoracic ring (scoliotic)	55
11.—Permanent pelvic obliquity	74
12.—Obliquity annulled	76
13.—Habitual pelvic obliquity	78
14.—Normal and flattened vertebræ	95
15.—A bad position in writing	106
16.—Another faulty position in writing	108
17.—Amesial pelvis	113
18.—Author's scoliosis gauge	123
19.—A left lumbar curve	134
20.—A right lumbar curve	138
21.—A dorsal curve (very early stage)	143
22.—Diagram of rotation	145
23.—A dorsal curve (later stage)	147
24.—A severe dorsal curve	151
25.—A low left dorsal curve	155

FIG.	PAGE
26.—An orthopædic support	158
27.—The sloping seat	173
28.—The sloping seat in action	176
29.—The loin bandage	177
30.—Rachilytic exercise for lumbar curve	181
31.—The shoulder sling	195
32.—The ring exercise	199
33.—Left respiratory exercise	202
34.—The lateral sling	203
35.—The lateral sling in action	204
36.—Dorsal rachilysis	208
37, 38.—The dorso-lumbar bandage	210
39, 40.—The rotation bandage	212
41, 42.—The side-bandage	230

ON LATERAL CURVATURE OF THE SPINE.

CHAPTER I.

PHYSIOLOGY AND ACTIONS OF THE SPINE.

THE spinal column consists (omitting the sacrum and coccyx) of twenty-four bones superimposed on each other. Each bone may be divided primarily into a body, and backward projecting processes; the body is the most massive portion and supports by far the larger part of the superincumbent weight. The processes consist of an arch formed by pedicles and laminae which enclose the spinal cord; thence project more or less obliquely upward and downward, the articular processes—sideways and backwards, respectively—the transverse and spinous processes; the function of the first set is to limit and direct movement, thus diminishing the chances of dislocation; the value of the last two is chiefly to afford many

2 LATERAL CURVATURE OF THE SPINE.

surfaces and projections for the attachment of muscles, while, in the dorsal region of the spine, the transverse processes also afford a second point of connection for the ribs.

In early life, however, the vertebra is not one solid and indivisible bone ; but is made of a number of separable parts conjoined by cartilaginous bonds called epiphysal. Thus not to go into unnecessary details, the whole mass of the pedicles, laminæ and processes are still separated by a thin junction line from the mass of the body.* More important,



FIG. 1.—Ossifying body with epiphysal plates.

ture of the bodies themselves, whose first centre of ossification appears in its mid-parts about the eighth week of foetal life (a little different in different regions), this gradually in-

creases in size, but a large portion of the upper and lower surface of every vertebral body remains cartilaginous during the whole period of bodily

* The centres for the arches and processes assist in forming the posterior-outer parts of the body in proportions that vary in each region of the spine.

growth, although about the tenth or twelfth year of life a bony centre appears in these parts, and slowly spreads laterally around so as to form about the sixteenth year epiphysal plates on both upper and lower surfaces, which remain separate for about twelve or fourteen years from the first appearance of the nucleus ; that is, up to the twenty-second or twenty-fourth year of life. Growth of the bone in thickness takes place by increase of this cartilaginous mass in the earlier years, and of this epiphysal junction in the later years of the above period.

Conjoined with this peculiarity in construction are certain differences, in the shape of very young vertebræ, from that of completely formed bones ; thus the characteristic form of adult bodies in different regions of the spine, oblong in the neck, triangular in the back, oval in the loins, is less clearly marked ; and, moreover, the articular processes, which in the dorsal and lumbar regions stand out as considerable projections, with surfaces facing in very definite directions, are in the quite youthful spine much less prominent and the surfaces lie pretty flat—in fact, they preserve in those two regions the sort of characteristics, which are found throughout life in the mid-cervical region.

It has been stated, and widely accepted, that the

4 *LATERAL CURVATURE OF THE SPINE.*

bodies of the lumbar and cervical vertebræ are thicker, those of the dorsal thinner, in front than behind.* This statement, however, is true only for a certain number of spines. I have examined a great many vertebræ, and in by far the larger number have found no difference whatever in the thickness of their anterior and posterior portions.†

The vertebræ, although superimposed, are not, save at the articular processes, in contact. The bodies are conjoined and separated by intervertebral discs, and are tied together by ligaments on their anterior and posterior faces. The arches and the processes are also bound together by ligamentous bands. These structures possess certain very important peculiarities. The intervertebral discs, forming about one-fourth of the whole length of the column, made up of fibro-cartilaginous material, with a central soft pulpy substance, are endowed with considerable distensibility, but with very little compressibility. The anterior and posterior common ligaments are situated, as their names imply, on the front and back aspects of the bodies—they are intimately connected, not merely with the bones; but even

* Weber, 'Die Menschliche Gehwerkzeuge.'

† Except the last lumbar vertebra.

more strongly with the intervertebral discs, being broader over the latter structures; they are composed of tough inelastic fibrous tissue.

The pedicles and laminae are connected together by strong bands of yellow elastic tissue, the peculiarity of this material is its great tendency to retraction, while it submits less readily to extension. The capsules of the articular processes are somewhat loose and thin. The inelastic white fibrous tissue, which connects together the spinous and transverse processes, are not important for our subject, except the strong cord of white tissue, stronger in the loins than elsewhere, called the supra-spinous ligament.

Thus results, as Hirschfeld pointed out forty years ago, a peculiar difference in the physiological tendencies of the bodies and of the arches. He cleared a column completely of all extraneous parts, leaving only bones and ligaments, and then with a fine saw separated all the arches from the bodies. The former, acted on by the contractile power of the ligamenta subflava, shortened itself by one-seventh, while the bodies, which when the column was entire, preserved the normal antero-posterior bends, became straight.* In 1875-6 I twice repeated this experiment with perfectly confirma-

* Canstatt's 'Jahresbericht,' 1849, p. 69.

6 LATERAL CURVATURE OF THE SPINE.

tory results. The same has also followed a repetition by Meyer of Zurich.*

The column of a healthy individual in the erect posture is not straight, but assumes certain antero-posterior curves in suchwise, that it is convex forward in the neck and loins, concave anteriorly in the dorsal region.

These normal curves are the result of the human erect posture. In babyhood the column is perfectly straight, that is, although its general tendency is to assume a simple curve, convex backwards, it has no inherent bend either antero-posterior or lateral; it simply takes the form of any surface on which the infantile body lies, or, when seated on the nurse's arm, it assumes one bend (convexity backward) the pelvis being horizontal, the thighs flexed. If such a baby be seen at a moment when it stretches, *i.e.* when it straightens out the thighs, the observer will perceive that the front of the pelvis is depressed, and the previously backward convexity of the loins becomes a concavity. Afterwards, whenever the infant tries to walk—whenever later in life the child or adult assumes the erect posture, *i.e.* whenever the thighs are placed perpendicularly, the front of the pelvis is depressed and incurvation of the loins follows. For when the pelvis is thus placed,

* Virchow's 'Archiv.,' vol. xxxv. p. 225.

the axis of the sacrum, traced from below, runs upward and forward, so also does the axis of the fifth lumbar vertebra, and in order to maintain balance in the upright position, the other bones of that region must of necessity assume a rather sharp curve (convexity forward), to bring the trunk and the line of gravity over the points of support—the feet. Thus these normal antero-posterior bends of the spine are essential to the human erect station, but the posture is nevertheless due to muscular effort, and is always abrogated in repose, as in sitting at ease or lying in sleep. Even the curve of the neck is produced by the strong muscles employed to keep the head horizontal.*

The column thus constituted is capable of three pairs of movements, flexion and extension, lateral bending to right and left and twisting to either side. All these are various in extent in different persons, but are all more free in youth than in maturer years. The first pair we need not further

* The foramen magnum and occipital condyles are placed far back in the skull, therefore the centre of gravity of the head is greatly in front of its points of support. The tendency to fall forward thus produced is in great part counterbalanced by some portion of the weight of the shoulders being suspended to the occiput by the anterior fibres of the trapezius—thus counterpoise is attained without expenditure of muscular force.

examine, but it will be well to study the two last a little more closely.

While the first edition of this book was in preparation, a work appeared which seemed to me singularly mistaken, in that it ascribed to the spinal column only a very slight and subordinate degree of mobility. I only refer to it now, as having supplied to me the motive for a very careful and extended series of experiments, designed to estimate the normal amount of spinal mobility. Only the gross results of these studies will be given here, since my first publications on the subject have set the question at rest. Suffice it now to say that, in order to elucidate in the living subject the amount of lateral mobility and torsion which the spine could perform, I procured a number of persons, active in habit, but unused to gymnastic, or acrobatic exercises, and caused them to assume such positions as were necessary for my purpose.

Let us first consider lateral flexibility : I soon found that it was impossible to obtain on the subject's body any sufficiently accurate measurement of the arc formed by a spine bent sideways, and therefore resorted to photography. The annexed plate gives an average figure ; it is not that of a person accustomed to athletic performances, nor was she at a very flexible period of life, she was thirty-two ; her left shoulder is placed against a wall, the left

side of the pelvis is drooped, and is made to approach the wall as near as possible. On this photograph a line was drawn from the root of the neck to the top of the *rima narium*. The curved spine from the vertebræ prominens to the top of



FIG. 2.—Lateral Flexibility of the Spine.

sacrum measured 13·5 lines, the radius of that curve, supposing it to be circular, was twelve lines. Now as the model's spine measured from the same points eighteen inches, the real radius of her lateral curvature was sixteen inches. The dorsal and lumbar spine of an ordinary individual about middle age,

can therefore bend laterally in a curve whose radius is eight-ninths the length of the column.

This amount of flexibility is static ; perhaps being somewhat forced, is a condition only rarely assumed ; but it must not therefore be supposed, that in the ordinary movements of life the spine remains straight. On the contrary, in walking, standing, or sitting, the body is constantly or frequently assuming varying positions, in which the vertebral column takes part. Every movement which alters the level of one or the other side of the pelvis, in other words, which causes its transverse axis to be oblique, produces a commensurate lateral bending of the spine. This may be observed by watching the movements of the figure of one sitting a skittish horse, or sailing over a chopping sea. It may be more systematically studied by causing a model to sit on a plank arranged to rock right and left upon a support—to sit, of course, immediately over the support, in which case the right and left side of the pelvis alternately will be raised. In figure 2 of the annexed diagram, the horizontal line represents the transverse axis of the pelvis on which the spinal column (the perpendicular line) stands straight and at right angles. The board rocks so as to raise the right side of the pelvis (diagram 1). The spine cannot maintain the same relations to the pelvic

transverse axis, as represented by the line A ; the person in such case would fall. It bends over abruptly towards the right ; but the centre of gravity in the human figure is low and this bend at the loin very sharp ; the upper part of the spine cannot, therefore, continue onward, as in the line B, the direction of the upper limb of that curve (viz. to B) ; but the upper or dorsal spine must compensate the abruptness of that curve by a bend in the contrary direction. Now the right end of the board, having completed its full swing upward,

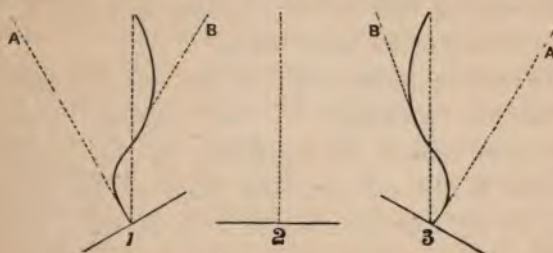


FIG. 3.—Diagram of spinal undulations.

falls again. The plank becomes horizontal and the subject sits on it upright and with straight spine (diagram 2) ; the rocking takes the contrary oscillation, the left side of the pelvis is raised (diagram 3) and the same conditions as are explained for diagram 2 are reproduced only in an opposite direction. Thus the two divisions of the spine undulate on each side of a perpendicular line

which, as it is the line of balance, passing through the centre of gravity, must always be preserved as the chord of any curves which the column may assume in all its erect postures. For instance, in walking even on level ground the lumbar spine curves in a slight degree each time a foot is lifted,* in ascending a staircase the curve is more considerable. If, however, any cause, such as uneven ground, a difference in the length of the lower limbs, an oblique seat, keep for a certain time one side of the pelvis higher than the other, the spine must, during that period, continue to curve, be it for a second or for some hours.

These movements and positions, due to muscular action, are permitted by and produce relaxation and tension of ligaments on the opposed aspects of the column, thus those of the arches, etc., are tight on the convex, loose on the concave side. The intervertebral substance is but very little or not at all compressed in the former; but is stretched in the latter situation.

To measure rotation, a somewhat more elaborate, but still simple mechanism was devised. A T-shaped piece of metal bears at the place where the two

* This movement is in men often very slight, in women is usually more marked, on account of their greater pelvic breadth.

arms intersect, a brass tube projecting at right angles. This has within it another tube capable of rotation, which bears a little clamp and screw. This T-shaped metal is so arranged that the perpendicular arm of the T lies on the sternum, the horizontal one beneath (not on) the clavicles, and here it is fastened by means of webbing-straps in such wise that in moving with the chest it is uninfluenced by any motion of the shoulders. A dial index, some ten feet above the patient's head, has depending from the pivot of the indicator a light pine wood rod. To put the appliance in use, the metal T is properly fastened as above described, the patient sits on a stool under the dial, the pelvis may, if necessary, be secured by straps round the upper part of the thighs, and for better attainment of immobility in that part of the body, the subject should grip between the knees a bulk-head, or other fixed object; the wooden rod is then fixed into the clamp and screwed firm. In the straight posture the indicator will be at 0, and will move as the patient rotates the spine to left or right, through a commensurate number of degrees, indicating exactly the amount of rotation which the dorsal and lumbar spine can achieve.

I found that in persons about thirty years of age the amount of rotation to either side is from 30° to

40° in each direction—that is from the extreme right to the extreme left twist from 60° to 80°, and occasionally I met with individuals, chiefly short, thick-set persons, who could only turn about 22° or 24°; but it was more common to find those who could turn more than 40°; these were as a rule, slim, slight figures; younger subjects of that build could not unfrequently rotate their bodies 60° in either direction; that is 120°, in both directions, or one-third of the circle.

The muscular mechanism of such rotation was for some time very difficult to elucidate. The more superficial muscles, and erector spinæ, can have no such action, nor can the spinalis dorsi, these fibres being parallel to the column. Of the deeper muscles, of the semispinalis, and of the multifidus spinæ generally, the same thing may be said, but perhaps a few fibres among the deepest part of the latter may have some such effect. The so-called rotatores are much too small and trivial to exercise any such power. Duchenne considered the semispinalis dorsi to be the chief agent of rotation; but it is greatly to be doubted whether, with all his ingenuity, he could pass a current into such deep parts, isolating all the neighbourhood.

While studying, by help of the instrument above described, the amount and the mechanism of spinal rotation, I was struck by the manner in

which the lower edge of the serratus magnus always marked itself out beneath the skin.

Here I must beg leave to diverge a little in order to call my readers' attention to the important functions and relations of this muscle. From the spinous processes of the last cervical, and three, often four upper dorsal vertebræ, arise two muscles, the rhombodei (which for our purpose may be considered as one), they pass outward and downward to be inserted into the base of the scapula. From this point the serratus spreads out over the side of the chest and is inserted into the nine upper ribs on the front-side aspect of the chest. The action of this muscle is in one sense on the scapula, namely, when that bone is by other muscles left free to move. In the first place it keeps the venter close to the chest wall.* Secondly, and chiefly by its lower fibres, by those which are connected with the lower angle of the bone and with the fifth, sixth, seventh, eighth, and ninth ribs, this muscle keeps that angle away from the spine, and therefore lifts the acronion and glenoid portion of the scapula, being called especially into play, when any weight is supported in the hand, or when the arm is raised over

* When this muscle is paralyzed, the base of the scapula protrudes very markedly backwards.

the head; for be it remembered the deltoid can only lift the humerus into a position, which causes it to lie in a line with the spine of the scapula, that is in the usual posture of this bone at about a right angle with the body. When the arm is to be still more raised the scapula must be rotated, on an antero-posterior axis, by action partly of the anterior fibres of the trapezius, but chiefly of the lower portion of the serratus, and in doing this the latter muscle takes its bearing from the ribs.

Many years ago Sir Charles Bell pointed to the inspiratory function of the serratus magnus and named the nerve supplying that muscle, the external respiratory.* The doctrine was received and taught for a long series of years without a doubt of its truth.

At the present day it is generally believed that the serratus has no such function as Sir Charles Bell ascribed to it, or at least that it is slight and unimportant, limited almost to slight lifting of the ribs in cases of severe dyspnœa. To decide in which of these two views lies the truth, requires some examination into the grounds of the recent scepticism. Firstly, several surgeons have galvanized the muscle and its nerve without being able to feel contraction of its serrations on the ribs.

* 'The Nervous System of the Human Body,' 1830.

Secondly, when, through certain diseases, the muscle has been paralysed, respiratory troubles have not been in most cases observed. Thirdly, in certain experiments on rabbits, even the highest degree of dyspnœa called forth no contractions of the serratus magnus, nor indeed of the two pectorals, sternomastoid, levator anguli scapulæ and trapezius.*

These facts must be taken to prove that Sir Charles Bell, and those who for many years accepted his views, did undoubtedly exaggerate the inspiratory value of the muscle in question, but I conceive that an equal amount of error lies in the denial of all inspiratory function whatever. Traube's experiments on rabbits are open to many objections—the position of the scapulæ and the form of the human chest are so different to those of quadrupeds, that one hesitates strongly to accept the muscular action of the one as identical with that of the other; indeed, those experiments, by sweeping away the action in breathing of so many muscles, which in man are involved in that function, prove the unreliable nature of this assumed identity. That difficulties of inspiration should rarely have been observed in cases of paralysis of the serratus†

* Traube, 'Gesammelte Beiträge zur Pathologie und Physiologie,' vol. i. p. 165.

† Oscar Berger, 'Die Lähmung des Nervus Thoracicus Longus,' Breslau, 1875.

proves indeed that the muscle is not essential to the act, even we may go so far as to say it shows that Sir C. Bell exaggerated its importance ; but, seeing that the function is most complicated, the loss of a muscle, not like the diaphragm of prime importance, may surely be compensated by others. -

Faradization of the muscle has been much practised, sometimes with a therapeutic, sometimes with an experimental, object. Duchenne,* being well aware of the doubts thrown on the respiratory function of the serratus, tested this muscle with the galvanic currents of two induction apparatus ; the one, three or four times as strong as the other, was applied to the rhomboid in order to fix the scapula, the weaker one to the costal insertion of the serratus—he observed, “ 1, direct elevation of the entire scapula ; 2, an upward and outward movement of the convex portion of the ribs, whose curve seemed increased. During the experiment the subject made a noisy inspiration, which he said he could not control. I repeated the experiment while closing the mouth and nose, and he felt a great desire to breathe at the moment of the muscular contraction.”

On the other hand, Berger tried this experiment on a patient, in whom, however, the muscle was a good deal atrophied, without producing any such

* ‘*Electrisation Localisée*,’ p. 306.

phenomena, and suggests that in Duchenne's experiment the current must have passed over to the phrenic, as does also Henle; a pure assumption which, in regard to so careful an experimenter, is not tenable, and which a perusal of Duchenne's words shows to be also impossible.*

In stating some paragraphs ago that Sir Charles Bell and the anatomists who succeeded him exaggerated the respiratory function of the serratus, I have conceded quite as much to the more modern views as my observations and experiments permit; for, having gone over the matter very carefully again, and as I believe without prejudice, the conclusion forced upon me is that the muscle takes an important part in the act of breathing, often but not always in actually moving the ribs; constantly in antagonizing the action of the diaphragm and of the external oblique abdominal muscles which, but for the serratus would drag those

* Henle argues that the manifold views concerning the mode in which the serratus could act as a respiratory muscle is a strong argument against its possession of such a function; yet he does not feel any uncertainty about the intercostals, although he says, three pages earlier, that some anatomists consider the external, some the internal inspiratory; others have held the direct contrary opinion; some have regarded the front of these muscles as antagonistic to the posterior part, and so on. (Henle, 'Handbuch der Muskellehre,' pp. 101, 103.)

bones in upon the cavity of the chest. Duchenne found, both in the living and dead, that Faradaic contraction of the former muscle raised and expanded the lower ribs while the abdominal viscera were in situ, but depressed and drew them inward in eviscerated animals; * the former effect is therefore evidently due to compression of the viscera from above by the diaphragm, and to their consequent lateral expansion; but the tendency of the muscle itself is to draw those bones in. This tendency is opposed by the serratus, which therefore is a safeguard against too violent a compression of the viscera.

The reader will call to mind the fact, that the fibres in the lower part of the serratus are almost in the same line as those in the upper part of the external oblique; therefore, it is a more direct opponent of this muscle than is the internal oblique, but the constricting action of both on the lower part of the thorax is antagonized chiefly by the serratus. At the termination of their rhythmic respiratory contraction, depressing the ribs, those bones are raised again by the serratus, not so much by an active contractile power as by tonic resumption of its previous length. I suppose the reason why so many observers have failed to feel any action of

* *Op. cit.*, pp. 350-357.

this muscle in breathing, is that they have felt for it on the ribs, where it cannot be verified, partly because their motion masks any such contraction, partly because so near its origin the muscle balls itself but little unless in violent action.

If, however, we strip the back of some thin but healthy person—a lad of twelve to fifteen years old is best—and telling him to breathe only very slightly beyond his usual very quiet respiration, watching his blade-bones the while, they will be seen to recede and approach the spine at every in- and expiration. This might be said to be due to movements of the ribs; but, if with the finger and thumb the serratus be gently grasped, just as it passes outward and downward from the angle of the scapula, its gentle and rhythmic contraction can be plainly felt. If the subject be directed to stoop forward from the loins without bending the dorsal spine, a position which, by somewhat compressing the abdominal organs, hinders the descent of the diaphragm, these contractions of the serratus can be still more plainly felt.

The studies which I have made of the breathing function convince me indeed that it is not to be regarded as always carried on under all circumstances by the same muscles: different postures of the body, though impeding the action of one or more muscles, are not permitted by nature seriously to

interfere with that vital act ; but on the contrary provision is made that the position which throws one or the other set of muscles out of gear shall



FIG. 4.—Rotating Action of Serratus Magnus.

favour other sets, thus enabling us to breathe easily and unconsciously in all but very strained and unusual circumstances.

While studying the amount of voluntary rotation of the spine as above detailed (see p. 14), I found without exception, whenever the body was twisted to the right or left, that the serratus was brought strongly into play, and formed on the plane of the back a strong ridge, running from the angle of the scapula, outwards and downwards to the side of the lower part of the chest. Of course, this line, which is the edge of the contracted serratus, is more marked in the more pronounced degrees of rotation ; but even very slight ones bring this muscle into action, as may be felt with the flat hand laid on the back below and outside the angle of the scapula.*

In order to understand this function of the serratus, the reader must remember the manner in which the ribs are connected to the spine. All the ten upper ribs have a twofold connection with the

* An attempt to deny this view has been made on singularly infelicitous reasons, viz., that as the muscle fixing the scapula is attached to the spinous process, no muscle arising from that point of bone could rotate the spine. (Fisher in '*Lancet*,' 1868.) Such reasoning could only hold if fibres continuous in direction were traceable from the spinous process to the rib of the same vertebræ ; but to deny that the ribs below the fourth cannot be drawn back, and the vertebræ rotated by muscles attached about and above the fourth spinous process, would be like denying that a man, because he was standing on the earth, could not lift up a spadeful of the soil.

24 *LATERAL CURVATURE OF THE SPINE.*

vertebræ, viz. by their heads with the body, and by their tubercles with the transverse process. This mode of attachment gives to the ribs, when acted on by the serratus, the action of levers of the second order; the fulcrum is at the head, the power arm is the stretch between that point and the attachment of the serratus, the weight arm is the distance from the head to the tubercle.

This turning action, though only directly exercised on the vertebræ of those ribs to which the contracting muscle is attached, is of course transferred in part to the bones below, according to their degrees of mobility. In thus considering this muscle as a rotator, it must be regarded in connection with the rhomboids as forming with them a wide, fan-shaped muscle, beginning at the lowest cervical and upper three or four dorsal spinous processes and sweeping thence round the side and front of the chest to its broad attachment at the ribs. In this view, the line of the base of the scapula may be looked upon as a mere intersection, like the *lineæ semilunares* of the *rectus abdominis*.

The above remarks refer to voluntary turning of the trunk, but there is a curious relationship between sideways bending of the spine and rotation of the vertebræ, inasmuch as any lateral bending of the column during life or after death involves at the same time a great tendency to rotation always

with the anterior faces of the bones towards the convexity of the curve. Eight years ago I instituted some experiments, not knowing at the time that they had been forestalled by Meyer of Zurich. On some minor points are differences between our results, but the most important ones tally. Having procured a fresh spine of a woman aged twenty-four, kept wet in a carbolic acid solution, I separated the ribs just outside the tubercles and cleared muscles, etc., away, leaving nothing but ligaments. The last lumbar vertebra was held firmly by a vice, and through the vertebral foramina of the axis threads were passed, which ran through pulleys on each side, four feet nine inches distant and on a level with the twelfth dorsal vertebra; the other end of each cord was attached to a hook to which weights could be suspended, whose action on one side or the other would bend the spine to right or left. The whole spine measured along the side, just in front of the intervertebral foramina, was 22·75 inches long, from the transverse process of the axis to the lower edge of the body of the last lumbar vertebra, and was absolutely equal on both sides. When by means of the weighted cord the column was bent laterally, so that a plumb-line fell five inches away from the centre of its base (last lumbar vertebra), the convex side measured 23·65, the concave side 22·40, showing an increase of length

on the convex side of 0·9, and a decrease on the concave side of 0·35 of an inch. It was several months before an opportunity of repeating the experiment occurred, and the spine was that of a tall man (6 ft. 2 in.), thirty-six years old. The column, treated in the same way, measured on each side 24·1—an unusual length; it was bent laterally as above until the plumb-line lay 6·5 inches from the centre of the base; the convex side then measured 25·3, the concave a minute fraction less than twenty-four inches—an increase of 1·2 inches on the convex side and practically no diminution on the concave.* Meyer's results, as far as this point is concerned, tally with mine, viz., that the intervertebral substances permit distension or lengthening, but their compressibility is very small.

Now, when either of these spines was bent sideways to a small degree, so that the pendent plumb-line stood away from the centre of the base only two inches or less, I perceived no rotation or twist of the vertebræ; but, when the lateral bend exceeded this amount, torsion immediately commenced.

* Meyer got some strange differences between bending to right and left. My attention was not specially directed to that point, and I can only say that, working as above described, with the weight, I found no such differences. Meyer bent the column by manual force, which can hardly be reliable.

The results of these experiments and the deductions to be drawn are of great importance, but before stating them I must disavow any claim either to originality or priority. My first experiments, those above detailed, were made without a knowledge, which, doubtless, I ought to have possessed, of Meyer's work ; they led me to the same deductions, which, however, in their broad outlines, are his property not mine ; while certain portions, not I conceive much less important, have seemed to escape his method of experimentation or his acumen. It was Meyer who first pointed out, that the cause of the connection between lateral bend and torsion depends on the essential differences between the qualities of the ligaments, which connect the bodies, and those which connect the arches (pedicles and laminæ) of the vertebræ—on the resistance of the former to compression, *i.e.* to being shortened, and the especial tendency of the latter to retraction ; hence, when the spine is bent laterally, the part which declines to be shortened takes up its position on the longest part of the curve, the convexity ; while that part, which loves to retract itself, seeks the shortest face of the curve, the concavity : hence, in bending the spine sideways, the bodies must of necessity move towards the most convex part, which they can only do by rotating on their axes, while the

arches, including the spinous processes, move to the concavity. The ligamentous mechanism, which has just been elucidated and given its full weight, assists, no doubt, in producing the phenomena of simultaneous lateral flexion and rotation in scoliosis, but it is not the whole nor even the greater part of the motive power, as I have abundance of evidence to prove. A voluntary sideways bend in the living subject can and often does take place without any rotation in the direction postulated, and I shall show by reference to scoliotic vertebræ that their form depends on the action of a force extraneous to the spine itself.

It has, moreover, nothing to do with voluntary or active rotation, the mechanism and measure of which were described at p. 22 and *seq.*

Certain parts of the spine are more mobile than others in the antero-posterior and lateral direction, the upper cervical from the second to the fifth inclusive are most movable; next in order are the two lower dorsal and three upper lumbar, the eight upper dorsal enjoy the least amount of mobility, partly on account of the way in which the ribs are attached, partly on account of rather greater overlapping of the laminæ and spinous processes. Nevertheless, I believe these differences of mobility (more especially in the direction of rotation) to be far less than is usually supposed, except in the case

of women long accustomed to wear corsets more or less stiff and unyielding. The mobility of all parts of the spine is greatest in infancy and early youth ; it decreases as years advance. By constant exercises, beginning in very early life, the spine can be made almost incredibly mobile. Many gymnasts, but especially one who went by the name of the man-serpent, have demonstrated how far this quality may be carried.

CHAPTER II.

DEFINITIONS AND DESCRIPTIONS.

The spinal column is, from a very early period of life, subject to several sorts of disease or deformity. One of these, "Angular or Potts' Curvature," consists in caries or caries necrotica of one or more of the bones together with destruction of the intervertebral ligament. It is, as Busch has pointed out, not so much a curvature as a "kink,"* and indeed the terms angle and curve are almost contradictory of each other. A curve is a line bent either into part of a circle, ellipse, parabola, hyperbola, or irregularly. Such deviation in the normal form of the spinal column may occur in four directions, forwards, backwards, to right and to left. The curvatures in the former two directions are called lordosis and kyphosis respectively, while the latter two curves are called lateral, or in more scientific language "scoliosis;" our studies will

* 'Handbuch der Allgemeinen Therapie,' 11te Band, 11te Theil, p. 110. The German word translated as above is 'Knickung.'

be confined to these last conditions. Firstly, however, it will be well to point out, what indeed has been already said, that certain postures of the body cause the spine to bend to right or left ; these bends are not, of course, included in the term curvature : in order to eliminate them, we place the person to be examined before us, with the feet together, knees straight, and arms hanging down by the side ; for the sake of brevity this is called "drill posture."

In very rare cases infants are born with spines laterally deformed, which in all probability results from ill development of one side as compared with the other side of the column, very probably due to the position of the fœtus in utero ; but congenital scoliosis is a pathological curiosity so rare, as not to invalidate the phrase that lateral curvature is essentially an acquired defect.

This acquired defect consists of two parts : of a deviation of certain portions of the column to right or left, and of a twist or rotation of the aberrant vertebræ.

Let us firstly consider the lateral deviation. This may affect any portion of the spine, though certain parts are much more prone than others to deviate ; it may also take place in either direction, hence a curve is named lumbar dorsal or cervical, according to the region it affects, and is also called right or left, according to the direction of its con-

vexity, occasionally the spine assumes one *simple* curve from the vertebra prominens to the last lumbar.* But more usually the curve affects in the first instance either the dorsal spine that is the nine upper bones of that region, or the lumbar spine, together with the two lower dorsal vertebræ; the former is called a dorsal, the later a lumbar curve: no doubt dorso-lumbar is scientifically a more accurate term; but, as it is also more clumsy, I shall use the simpler name. In either case the ninth, sometimes the tenth vertebra is the nodal point of the arcs, which alternate to its right and left. Cervical lateral curve in the proper sense of the word, that is, exclusive of wry-neck, is not known as a primary affection, but only as secondary to severe dorsal curvature.

Either a dorsal or a lumbar curve may be the original, and for a certain period, or up to a certain degree of intensity, the sole defect; but after that period, or when that stage has been reached, the original evil calls forth, in the hitherto unaffected area, a curve in the contrary direction. The former of these is termed the primary, the latter the consecutive or secondary curve, the whole deformity being named an S-shaped curvature.

* Peculiar as a rule to the very young and often the initial phase of the sort of curve next defined.

Occasionally, the spine instead of assuming in its dorsal and lumbar regions, only two contrary curves, lapses into several, alternating with each other throughout those portions of the column ; such condition is called multiple curvature.

The simple or, as is sometimes named, the total curve is almost confined to very young subjects ; it is simply a lumbar curvature continued onward into the upper regions of the column, and nearly always has its convexity directed towards the left. Moreover, a curve of this sort is not unfrequently a mere transition phase of the S-shaped curvature, the lower limb of the arc becoming more sharply accentuated, while the upper limb gradually assumes a contrary direction.

The more usual direction of a primary lumbar curve is to the left, and commonly this is followed by a higher dorsal curvature to the right.

Again, primary dorsal curve is usually to the right ; it is accompanied by a consecutive lumbar curvature to the left, and, if it be pretty severe, also by a curvature to the left in the cervical region.

My personal experience of these curves is that primary lumbar to the left and primary dorsal to the right are about equally common, but my notes show that the former begins as a rule earlier in life, that is children, who become affected with spinal

34 *LATERAL CURVATURE OF THE SPINE.*

curvature before the seventh year, have more usually lumbar curve to the left, often continued upward as above described, while those whose curvature commences about the tenth year are more prone to right dorsal curve.*

All curvatures are much more common in the female than in the male sex; yet in young boys, even in older ones, about the age of puberty, lumbar curvature from obliquity of the pelvis, is by no means uncommon; they recover, however, more easily than do girls.

Certain statistic records concerning the relative frequency of curve in different ages and direction of curves in the two sexes may here be given. My own notes, which were not taken for statistic purposes, and therefore may not be in that view very reliable, show eight and a half per cent. occurring in males of all ages. Mr. Adams gives the number of cases attending during a certain period at the Orthopædic Hospital as 173; of these, 115 were females, 22 males, or 12·75 per cent.†

* The reason why the curves in the different regions have the peculiar tendencies to left and right respectively are given in subsequent chapters.

† This percentage is much higher than mine. It is probable that among the class of patients attending the hospital, rickets is a far more frequent cause of curvature than among those who consult privately, and rickets affect both sexes.

Mr. Tamplin* gives a record from the same hospital of 569 of dorsal curve, whereof 470 cases were to the right, 99 to the left.† With regard to the age at which lateral curvature commences, the best numerical gathering is that of Eulenburg; he collected, with the object of ascertaining this point, 1000 cases, and tabulated them thus:—

			CASES.		PER CENT.
Previous to 2 years old	..	..	5	..	0'5
Between 2 and 3	..	..	21	..	2'1
" 3 " 4	..	..	9	..	0'9
" 4 " 5	..	..	10	..	1'0
" 5 " 6	..	..	33	..	3'3
" 6 " 7	..	..	216	..	21'6
" 7 " 10	..	..	564	..	56'4
" 10 " 14	..	..	107	..	10'7
" 14 " 20	..	..	28	..	2'8
" 20 " 30	..	..	7	..	0'7†

By which it is plain that more than half the total number of cases originate between the seventh and tenth year; but it is permissible to wish that Eulenburg had continued his one-year

* 'Medical Gazette,' Oct. 13, 1849.

† Here again rickets in all probability increases the numerical proportion of left dorsal curves. In both the Cripples' Homes (boys and girls) to which I am surgeon, there are a far larger proportion of left curves than in my private practice.

‡ Eulenburg, 'Die Seitlichen Rückgrats Verkümmungen,' Berlin, 1876, p. 76.

numeration, at least up to the tenth year, because the three years previous to that age do not embrace thrice the number of cases included in the one year between six and seven. We have, however, this fact clear, that, out of 1000 cases, 887 begin between the ages of six and fourteen, or 88·7 per cent. The sudden rise in frequency between the ages of three and four, and its decline after the latter age, are to be ascribed to the debility, and to the occasional nerve-irritation produced by the first dentition.

In the foregoing chapter much was said about rotation of vertebræ: it was shown that this is effected in voluntary turning of the trunk upon the pelvis by muscular action; but often in oblique postures the superincumbent weight of the trunk is thrown upon the ligaments. The different qualities of those between the bodies and those connecting the arches tend to rotate the vertebræ on their axes. Now though, in assuming any such position, muscles put the trunk into the desired posture, yet quiet maintenance of the trunk in the position depends chiefly on the ligaments.

The direction of rotation is always such that the anterior face of the vertebral body looks towards the convexity of the curve, the tips of the spinous process being carried into the concavity. And yet this hardly represents all the elements of the move-

ments, for if a thus distorted spine, bared of ribs and muscles, be studied in all its complex form, it will be seen to lie not in a wavy but in a spiral line ; it seems as though twisted round a central stem, against which the spinous processes abut, while the centre line of the bodies lie in the widest gyrations of the cork-screw curve. Thus this latter line is very much longer than that formed by the arches and processes, by virtue of the different qualities of extensibility and compressibility possessed by the ligaments of those parts (see p. 27), and also its lateral deviation, is very much greater ; indeed, while these parts may be very much curved, the tips of the spinous processes even in a pretty severe case may lie in a perfectly straight line. The clinical result is obvious ; the tips of the spinous processes have all moved towards the concavity of the curve, *i.e.* nearer to, or absolutely into the perpendicular. Hence examination of the living body may show these bony points to be in a straight line, even although there may be considerable curvature. Other clinical symptoms are due to this rotation, namely that



FIG. 5.
Diagram of Spi-
nal Twist and
Rotation.

the lateral parts of the spine (the transverse processes) and those that are there attached (the ribs) lie in different antero-posterior planes; those on the convex side abnormally far back, those on the concave side too far forward. Again, the course or direction of the ribs is changed; on the convex side, those on the upper limb of the curve run too much upward, those on the lower limb take a too downward course, they diverge so that on the side-outline they are abnormally far apart. On the concave side they run down on the upper limb, upward on the lower limb of the curve, they converge so that at the side they are too close together.* The result being that the side of the chest measured along a vertical line from the axilla downward is lengthened on the convex, shortened on the concave aspect of the curve. But more important for our immediate purpose is the displacement—the obliquity of the plane of the back in different regions. Thus if the plane of the posterior surface of the pelvis on a level with the postero-inferior spines of the ilium be taken as true (*p-p*), that of the loin at the second lumbar vertebræ will lie so that its left lateral half is behind its right

* For sake of simplicity the matter is thus put here. The very complex subject of position of the ribs will be more fully explained hereafter.

half ($l-l$), and in the dorsum the right half will be behind its proper place ($d-d$). Thus let the lines in the diagram represent the section of these different planes; the full dark stroke that of the pelvis ($p-p$); the interrupted one that of the

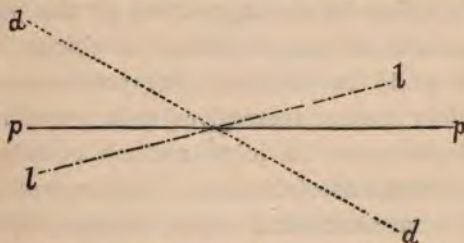


FIG. 6.—Diagram of Rotation Plane—($p-p$) plane of pelvis ; ($l-l$) of loins ; ($d-d$) of dorsum.

loins ($l-l$); the dotted one that of the dorsum ($d-d$); the former at an angle of 15° , with our base line ($p-p$); the latter at an angle of 35° , therefore the angle at which the lumbar and dorsal planes stand to each other will be 50° .*

Combined with these changes in a great many cases, is obliteration or considerable diminution of the normal antero-posterior curves. Some writers, for instance Meyer,† appear to consider it a con-

* This measurement of the angles of different planes is made by an instrument hereafter to be described, by which I find such figures as are given in the text represent no unusual degree of curvature.

† Loc. cit., p. 220.

stant or indeed a necessary phenomenon. Adams, however, is clinically more correct in speaking of it as a frequent occurrence.* I would, however, rather describe it as occasional; in many cases I have observed strongly marked scoliosis of the dorsal region with exaggeration of the posterior curve, and more cases in which no change of such nature could be verified. But patients not unfrequently present themselves with a well-marked lateral curve of the loins, and an equally well-marked kyphosis of the back. It is very difficult to say on what anatomical conditions these differences depend; for it is evident that when the column is twisted the antero-posterior curves should be commensurately diminished, and when this does not take place, *a fortiori*, where the anterior bend is increased, there must be a further deflection added on to those just described; a bend which must affect the twisted vertebræ chiefly on the side which now looks too much forward—and yet, as I have frequently observed, perfect rectitude of the column in the antero-posterior direction adds considerable gravity to the diagnosis as also does kyphosis.

For the sake of classification and distinction, lateral curves of all sorts are divided into three

* Loc. cit., p. 102.

stages; in order more clearly to explain these, I must repeat that lateral differs from angular curvature in that it does not originate (save possibly in the rare congenital form) in any diseased state of the vertebræ.*

THE FIRST STAGE commences in a position which may be merely a bad habit; may be the result of avocation or employment, or may be forced upon the spine by certain defects of other parts. By whichever of these causes the malposture is produced, it remains for a certain time nothing else than the effect and result of muscular force.† The clinical signs of this condition are capability of temporary and complete restoration of rectitude, by replacing the pelvis in its normal horizonticity; by manual pressure, by recumbency, or by other means, which will come under the head of diagnosis. As this phase is a condition rather than

* I do not even exclude rickets. The soft condition of bone substance in that disease renders the vertebræ more prone to yield to any deforming force, but does not itself constitute such force.

† Further elucidation of this theorem will be given in a subsequent chapter, but I would say here that this action of muscles is not in itself morbid. On the contrary, their mode of contraction is perfectly normal, and I wish expressly to disclaim all idea of an excessive or "spastic" contraction, such as Guérin and Tamplin imagined to exist.

a disease, it has no anatomical or post-mortem appearances.*

SECOND STAGE.—Next comes a stage when as yet no sign of change in the shape of bones can be clinically detected, and yet when neither recumbency, suspension, nor pressure with the hands, will eliminate, though they may diminish, the curvature. This phase corresponds with the following organic changes : The characteristic posture has been for a given period maintained by muscular action, that is to say, certain muscles have kept themselves in a state of more or less constant shortening. After a time those muscles cannot resume their normal length without causing an uncomfortable sense of stretching and fatigue ; the patient therefore only feels straight when yielding to this altered condition of muscles, that is to say, when he really is crooked. Hence the position, at first only assumed while standing, is after a time maintained also in sitting, subsequently even during recumbency. The muscles, at first merely contracted, become by degrees slightly contractured, that is to say, their fibrous and connective elements

* The limb shortened by disease, will show evidences of that abbreviation and disease, which however are not those of scoliosis.

(sarcolemma, septa, and fascial sheaths), shorten themselves to the new position, though never to the same degree as in anchylosed limbs, they can (post mortem) be again extended to their normal length by traction with the hand. On the convex side, the lengthened muscles are pale, thin, weak and badly nourished.

Meanwhile, the ligaments alter much in the same way as those fascial constituents of the muscles. It has been already explained (p. 12) that during any temporary flexion of the spine, the intervertebral discs become a very little thinner on the concave, thicker on the convex side of the column; but if this bend be maintained for a lengthened period, these discs, which bear compression badly, lose to a commensurate extent their elasticity, in the convexity they remain thick; in the concavity, instead of permitting or aiding, as they ought, the approximated sides of the vertebræ to separate again, bend them persistently in their abnormal immobility. Later, however, in severe cases, the sides of the discs in the concavity become very much thinned, sometimes to such a degree that at their edge the bodies of the vertebræ come into actual contact. It is a natural consequence that in the shortened and hardened condition of one side of the disc, the relaxed and softened condition of the other, the *centrum pulposum* should move away

44 LATERAL CURVATURE OF THE SPINE.

from the median parts towards the convex side, that is from the compressed towards the laxer portion of the disc.*

The anterior and posterior common ligaments also suffer changes, as Nicoladoni was the first to point out.† These bands are sufficiently broad to be affected on their opposite edges in different manners. When the column is persistently bent laterally that edge which subtends the convexity is kept on the stretch, while that on the side of concavity is relaxed; the former, therefore, like all continuously stretched white fibrous tissue, becomes thin, wasted, and disintegrated; the latter, while shortening itself to its approximated insertions, becomes thicker and stronger. Boulaud found the anterior common ligament thicker and firmer in the concavity of the curves, and at the same time tightened like a tendon, while on the concavities it had become incorporated with the periosteum.‡ Also both these ligaments have a tendency to shift their position on the faces of the bones from the convex towards the concave aspect of the curve.

* Certain writers consider that this lateral position of the pulpy centre is a *cause* of the curve, evidently an untenable theory.

† 'Die Torsion der Skoliotischen Wirbelsäule,' 1882.

‡ Eulenburg, loc. cit., p. 141.

The ligaments of the arches undergo a similar change. Of these the most important is the elastic yellow tissue of the pedicles and laminae, which, owing to their inherent contractile quality, very quickly shorten on the concave side of the column, while they are stretched and somewhat atrophied on the convex side. Thus the clinical second stage of curvature corresponds pathologically with organic shortening of muscular and ligamentous structures, in the concavity of the curve—lengthening and weakening on the convexity.

THIRD STAGE.—A certain time after, in some cases almost simultaneously with the commencement of these changes in the soft parts, modifications in the shape of the bones usher in the third stage. These modifications affect primarily and principally the vertebræ and the ribs. My constant watchfulness for some opportunity of examining anatomically a young subject with curvature in the very beginning of this stage has not been rewarded, I cannot therefore say which of these sets of bones change first, or if they do so simultaneously, nevertheless in our description the vertebræ may have precedence. I shall take as an example a far advanced case, as the alterations can be thus more easily appreciated, but it must be understood that what is about to be described is the result of a gradual process: more rapid when the subject is

growing quickly, much more slow when increase of stature is almost at a standstill.

The changes in the vertebral bodies are caused by unevenly distributed pressure, which results partly from rotation, partly from lateral deviation. In a spine thus deviated, the superincumbent weight falls chiefly on that side of the bones which subtends the concavity. The vertebræ are at this



FIG. 7.
Front View of Vertebræ. Discs strongly, bones slightly wedge shaped.

phase of life largely composed of cartilage and are engaged in the process of growth. Now pressure in a given direction hinders, while absence of pressure favours growth, hence when this unilateral pressure has continued a certain time the bodies of the vertebræ, growing less on the concave than on the convex side, become wedge-shaped—thinner, that is to say, on the side of the concavity,

thicker on that of the convexity. This alteration may proceed while the vertebral body is, with the exception of an osseous nucleus entirely cartilaginous; or if the curvature have delayed its advent to a later period of life, till after the appearance of the epiphysal plates, the change will be effected by one-sided growth at the upper and

lower epiphysal junctions, just as a genu valgum is produced by overgrowth on the inner side of such junctions at the femur and tibia.

If the intervertebral discs have become so thin that the edges of the vertebræ in the concavities come in contact, small osteophytes are formed in the neighbourhood which may unite the bones. In severe and old cases these edges may be joined by actual synostosis.* But, while pressure from above downward checks growth in those directions, it does not hinder, but rather aids increase both in the lateral and antero-posterior directions. Thus the left (concave) side of a scoliotic vertebral body is not only thinner but also both deeper from before backward and wider than the norm. This, of course, gives to the bone a very unsymmetrical appearance. But it is not merely appearance which leads to our conclusion on the above causation; nature gives us anatomical proof, in the position of the opening for the basic vein or veins. This or these, for there are usually more than one, lie no longer in the middle of the posterior surface, but considerably to the right. Of course, it is not for a moment to be imagined that the opening has shifted its position in a bone not otherwise changed: therefore, the only explanation is that the

* 'Hunterian Museum, Pathological Series,' 2099.

body to the left of the openings has grown laterally very much more than it has to their right. Indeed, in far advanced cases, like that shown in Fig. 8, this left-sided growth is evidenced on the posterior face by an entering angle (in which lies the emunctory opening), at the line of junction, between the wide-growing and the high-growing part of the bone. On the anterior and antero-lateral aspect (concavity side) of some vertebræ, oblique striæ may be observed ; they probably indicate that the osseous fibres have been twisted while soft, during and by the rotation ; or they may be marks left by an overtight and shifting anterior common ligament.

The arches and processes are also the site of very remarkable changes, the causes of which, after having described them, I shall attempt to elucidate. On the left (concave) side the pedicle takes a less backward course and runs more transversely than it ought to do ; it is short and stunted ; the lamina is long but narrow, the articular process shrunken in all dimensions.

On the convex side the pedicle is long, strong, somewhat hypertrophied, the pedicle broad but rather short. In consequence, the spinal foramen is wide from before backward on the left, but narrow and long on the right side.

I would now especially direct the reader's attention to the very remarkable changes which affect

the processes—transverse and spinal. On the left (concave) side the transverse process runs in nearly its normal direction, only a very little too far backward. On the right (convex) side that process takes a greatly backward direction; it is thin at its root and altogether less strongly developed than on the left side. In consequence of these varying directions, the vertebral groove on the right side is deeper, but more especially narrower than in the normal vertebra, while on the left side it is considerably widened. The root and first part of the spinous process is straight; but at about half its length it takes a bend towards the right, a bend which is the more marked the earlier in life the curve began.

Let me now beg the reader to examine carefully Fig. 8, and to trace in his mind the sort of force which, while producing rotation, has also caused these alterations in the shape and the direction of arches and of processes. The question to be solved stands thus: Is the spine rotated by a force, proper to the column itself, such as the unequal retraction of ligaments, dragging the ribs on the convex side with it? or does some power acting on the ribs use those bones as levers (see p. 24) and turn the vertebræ on a vertical axis?

Now, if the former were the mode of rotation, if the rotating vertebra dragged the rib after it in its

revolving course, that rib must of necessity resist, and the transverse process of the right (convex) side, still in the yielding condition of early life, would by that traction become drawn into an abnormally transverse direction, and the vertebral groove of that side would be widened. Also the transverse



FIG. 8.—A Scoliotic Dorsal Vertebra (after Lorenz).

process of the left (concave) side in pressing its attached rib forward must be forced into an abnormally antero-posterior direction; but any one who will study Fig. 8 will see that the direct contrary is the case. And in order to eliminate any idea that preconceived notions of my own may

have guided my pencil in the sketch, I have taken the figure from a most determined opponent of my view, that the ribs rotate the vertebræ, viz. from the book of Dr. Lorenz ; only, Dr. Lorenz's figure represents a bone from a dorsal curve, convex to the left. In order not to produce any confusion, since I have always taken my description from right curvature, I have reversed his figure, thus making it a vertebra from a right curve.

To follow, then, this argument still further, let us suppose that the rib works, as just stated, after a lever-like manner, in rotating the vertebra. Such force acting on the still soft transverse process must press it inward towards the middle line and would thereby compress, *i.e.* shorten the lamina, while lengthening by traction the pedicle : thus the vertebral groove of that side must be narrowed. But the muscles, *ex. gr.* the right rhomboids and trapezius attached to the tip of the spinous processes would resist the rotation and thus bend those points of bone to the right. I must say it appears to me impossible to look, as I have done, at a number of rotated vertebræ without coming to the conclusion, that it is *not* the vertebræ which rotate and carry back the ribs, but the ribs which travel backward and turn the vertebræ round. Moreover, we shall see directly that the right ribs, those on the convex side, are sharply bent ; if the

rotating vertebræ did, in their revolving course, drag the ribs backward, the resistance must inevitably unfold the angles, *i.e.* flatten the bone instead of crumpling and sharpening those angles as the rotating force in reality does.

A most complicated and difficult study is presented by the varying position and shape of the ribs on the right and left side, the former are chiefly due to the displacement of the vertebræ. We will defer for the present speaking of their backward projection on the right side, which is connected with rotation, and fix our mind for the moment on the mode in which lateral deviation—the pure sideways bend—affects the course of the ribs. On the convex side, those which are attached to the upper limb of the curve must of necessity take an upward, those on the lower limb, a downward course; thus they diverge, the intercostal spaces are wide and the length of the thorax, on the side outline, from the axilla downward, is much increased. On the concave side, the reverse is the case, on the upper half of the curve the ribs run downward, and on the lower upward; they converge and the lateral wall of the thorax is shortened. If the ribs were mere passive outgrowths from the spine, without other attachments, this would be all that need be said; but as they are bound together, upheld by some muscles, depressed by others, the simple change of

position, above indicated, is the merest rudiment of the complicated derangement of form and place

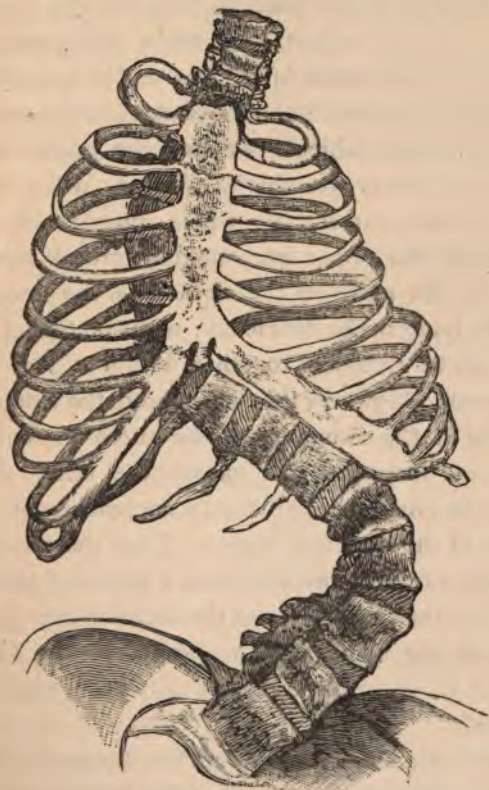


FIG. 9.—Scoliotic Skeleton.

which affects the ribs. To attempt description of them in detail would be out of place in a work like

this which, aiming at scientific accuracy, would yet avoid such minutiae as, however interesting to the investigator, would tend to obscure the practical points of the subject. Moreover, the position in regard to each other of the ribs varies according to the amount of curve and to its place in the column ; thus, in some subjects, we find the upper, and in others the lower ribs chiefly affected ; while in long and severe curves, the whole number may be involved, the upper one making protuberant the root of the neck on the right side, the lower one (10th) lying in the iliac fossa ; while on the left they may all be crowded together within a very small compass. However they are placed, the side of the thorax in the convexity of the curves is rendered, not only long, but also narrow, the latter change being in great measure due to encroachment on its space of the vertebral bodies. Thus there is in the College of Surgeons' Museum, a distorted skeleton, in which the space between the anterior (now lateral) part of the spine and the bodies of the fifth to eighth rib inclusive, averages only three-eighths of an inch.*

The increase in length of the thorax is due to the considerable divergence of the ribs, which causes the inferior ones to be lower, the superior higher in

* Patholog. Series, No. 2099.

the figure, indeed if the curve be high, in which case consecutive cervical curve will exist, the first rib runs so much upward as to cause fulness at the lower part of the neck.

These are not the only changes in position, for the transverse processes on the right (convex) side are, as the reader will recollect, deflected by the pressure



FIG. 10.—The 5th Thoracic Ring (after Lorenz).

of the ribs considerably backward. This connotes that the first part of those bones, from the head to the angle, must lie in an abnormally antero-posterior direction. But in thus deflecting those processes, the ribs also rotate the vertebræ, thus acquiring a still more backward course—indeed in severe cases this

first portion of the ribs appears to run straight back from the spine. In assuming this posture, much resistance is of course offered by the bones on the other side of the chest, by muscles opposing the serratus, chiefly by the external oblique, by the diaphragm and other parts, which counteract backward movement of the body of the rib. The necessary resultant of the two forces is a very sharp bend at the angle—which is decreased often to a marvellous degree, as in the Museum specimen above referred to. At the same time the ribs on the other (concave) side are flattened chiefly, in all probability, by pressure of the rotating vertebra. The angle becomes almost lost, the bone assuming a sextant-like curve from the head nearly to the distal end. In severe cases this distal end is bent back more or less abruptly to meet the cartilage, which is likewise bent, and in such instances the sternum also is oblique, the left edge being considerably in advance of the right one.

It is to be noted that the oblique diagonals—the lines traced on each side from the angles of the ribs or from where the angles should be—to the ends of the bony ribs on the other side, are very different in length, while normally they ought of course to be equal. The line which runs from the place of the angle of the left ribs to the end of the right ribs is very much shortened, while that which passes from

the angle of the right, to the end of the left ribs is excessively long. Again, if a line in the true antero-posterior axis be drawn through the vertebra, very little of the thorax lies on its right, while a very large portion of that cavity is placed on its left side.

But such changes involve a further alteration in the shape of the chest, which is no longer symmetrical. A horizontal section of a far advanced case would present a most singular and almost incredible appearance, whose general form may be somewhat gathered from Fig. 10. Having, however, had no opportunity of making such section I will not attempt to give a diagram on supposititious grounds, although I believe myself to know perfectly the form it would present.*

A necessary sequence of these changes is displacement of the viscera. Those of the thorax suffer little, until a great degree of deformity is reached, and then they become very much more misplaced than is, I think, generally believed. But

* I would again remind the reader that cases of curvature vary considerably as to place and severity ; hence the form of the anterior parts of the thorax differs greatly. Thus in some persons the sort of sternal obliquity mentioned in the text is absent ; in some (those where the lower limb of the curvature is sharply developed) another obliquity is present, namely, the lower end lies to the right of its proper place, the upper end being mesial ; moreover, the costal cartilages are much bent in some, very slightly in other cases.

a difficulty arises in forming a judgment of this condition, because the landmarks have also been removed. Again and again I have heard physicians say, when finding the heart beat below the left nipple, that the organ is not displaced ; and, with regard to the chest-wall, this is true ; but that wall itself is out of place. In June, 1882, I had the opportunity of examining a girl, aged 19, who, after a short illness from pleuro-pneumonia, died of exhaustion and apnœa. She had a most severe lateral curvature. I was forbidden to, and could not remove any part. During life the heart-apex appeared to beat in the right place, but on removal of the anterior chest-wall the displacement to the left was very striking. A cord stretched from the chin (head held straight) to the pubes, passed over the right lung about two-thirds from its outer border, leaving one-third between it and the outer uncovered edge of the pericardium. The right lung, though, as regards the anterior thoracic wall, still in that side of chest, was to the left of, and lying on the left side (now anterior) of the bodies of the vertebræ. It was deeply marked by the ribs, was small and somewhat solid. The left lung was large—its emphysematous condition may have been the result of independent disease. The diaphragm was high on both sides, chiefly on the right. The right side of the chest seemed almost entirely

occupied by the bodies of the vertebræ. At the apex of the curve, the inter-vertebral ligament was absent or nearly so, and three of the vertebræ, very rough and uneven, appeared anchylosed. I could feel, rather than see, in the small, dark room, that the left edge of the anterior ligament was thick and tight, its edge between certain of the vertebræ feeling very sharp and hard. I detected nothing morbid in the abdominal viscera, except that the liver was very convex, almost conical on its upper surface, thick from above down, and had two very deep sulci impressed by ribs, but the examination was made under great difficulties and closely watched. It may be difficult to affirm what may be the symptoms resultant from such disturbance of place. One thing we find at the Cripples' Homes, that if any inmate, thus deformed, be attacked with bronchitis or pneumonia, it goes very hard with him or her ; and some die with a much less amount of disease than would be fatal to a well-formed person.

When patients with severe curve get into years, they age and become feeble very quickly, suffer from apnœa, and even very slight exertion is apt to induce severe palpitation of the heart.

CHAPTER III.

PROGNOSIS AND HEREDITY.

A VAST number of circumstances must influence the prognosis of Lateral Curvature. Among the most important is the stage which the deformity has reached, before coming under treatment, and the period of time which the patient has taken to reach that stage.

For it is remarkable how various are the rates of rapidity with which the three phases succeed each other in different cases. In some, even though the deviation may have commenced quite early, say about the seventh year, progress is slow, while other less fortunate patients become rapidly much deformed. This rapidity depends in some instances on softness of bones, often ascribed to rickets. Doubtless in a certain number of such rapid cases, rhachitic malacia does exist; but, especially among the well-to-do, only in a small percentage. I have again and again sought in vain for any of the well-known signs of such disorder; indeed, my note-book contains five cases of remark-

ably quick deformation, in which long straight limb-segments with slender terminations and absence of rib-bending were noted. In all these instances, as in very many others, a rapid body-growth had preceded the discovery of the deformity. Hence we may infer, although there is no anatomical proof, for such opportunities very rarely occur, that just as the cartilaginous were becoming ossified into bony vertebræ, great plastic activity was in progress, and that at that special time an unfortunate position, adopted as the most restful, or as the easiest way of carrying on some avocation, was such as weighted one side of the vertebræ almost to the exclusion of the other; therefore, on the weighted side, that of concavity, the vertebral body growing less, become thinner than on the convex side. Thus is laid, if I may use such term, an architectural foundation for crookedness.

Few cases, however, run thus rapidly into bony change, but remain in the phase of muscular and ligamentous contraction, including wedge-shaped vertebral discs, for a more or less considerable period.

Indeed, much crookedness may, for a given period, coincide with perfectly normal bones, for not every case with a pristine rapid progress and *à fortiori* not every slower case is destined to reach the third stage; more especially with the latter, it

happens, that the progress of the malady may become naturally somewhat checked, somewhere between the nineteenth and twenty-fourth year, according to the period when growth ceases ; hence, as is obvious, this cessation of deforming activity occurs under the more favourable condition, the later in life has been the commencement of the evil, and the slower its meantime progress. Unfortunately, however, this is very often not the end of the history. As long as the vigour of youth persists, the spine retains much the same degree of malformity as it had reached when the pause set in ; but, when that youthful condition has passed away, more especially if some acute or sub-acute debilitating disease have intervened, the spine will again yield, more or less rapidly according to the bodily weakness. I have notes of many such cases, the patients saying that earlier in life they had been known to be crooked ; but that for ten or twelve years the distortion had not increased, even they think had decreased ; and that then rather suddenly they had begun again to get worse. A debilitating illness may originate this backsliding ; but marriage, or rather its result, pregnancy and childbirth, must be reckoned among the more usual causes of relapse ; of course, the more frequent and the more rapidly recurring be these events, the more inevitable and the quicker will be the spinal

changes of the mother. Moreover, many of those cases, which have been naturally or by treatment checked in a certain stage of the deformity, may continue, if none of the above conditions intervene, in that degree of crookedness until advanced life, not to say senility, brings on a sudden and often extremely rapid deterioration, one which is often very difficult to check, because many of the means we can employ in comparative youth are unbearable in age.

The prognosis of lateral curvature thus evidently depends on a great number of conditions : viz., on age ; on the rapidity hitherto of its progress ; on the presence or absence of rhachitic symptoms ; on delicacy of constitution and accidental illness ; on heredity or non-heredity, and on the stage reached before it is brought to skilled notice. Although it is manifestly impossible within reasonable limits to describe all the combinations, in various proportions of these many circumstances, we may indicate their general effect. Rickets has a grave import on the future of these cases. A very early commencement, between two and six, is not a favourable condition, more especially in dorsal curvature, whereas if the malady begin and be brought under proper treatment between seven and ten years of age, the circumstances, in the absence of rickets, are advantageous. A rapidly increasing deformity

is very grave, especially if it be let alone or inadequately treated; but the conditions on which that rapid increase depends, viz. deep and proliferating epiphysal junctions, are such as render an assiduous and well-arranged system of treatment particularly efficacious. Here, the reasonable assent and co-operation of the parents, together with docility and patience on the part of the subject, are of the highest importance. Of heredity, more will be said immediately: when it is maternal and plainly traceable, especially if the child be the last of a series rapidly produced by a weakly and relapsed or relapsing mother, the prognosis is bad.

All and each of these considerations, as regards the future, are greatly modified by the stage attained when the individual is brought under skilled care. The first stage (unless in severe rhachitis) is eminently curable, the fact of rapid development should be by no means discouraging. If parents and patient co-operate with the surgeon, not only can the progress of the deformity be checked, but its retrogression secured.

The second stage is also curable, but a longer time, greater perseverance and a more potent form of treatment will be necessary; in fact a certain part of each and of every day must be devoted to the object in view, and at no time must the condition

be so far forgotten as to permit the resumption of an old, perhaps almost disused, objectionable habit.

The third stage may or may not be curable, according to the age of the patient. It may seem bold to assert, that when the bones have become altered in shape, a cure may nevertheless be possible; but in quite young subjects, say under ten or even under fifteen, if juvenile at that age, I believe this to be the case; I cannot prove it, not being able to dissect a patient first, and cure her afterwards; but I have had to treat and have treated successfully several quite young subjects, so much deformed that I could not doubt the third stage had set in. In later life, say after sixteen or eighteen, the third stage is incurable, though it may be greatly benefited.

An advanced third stage cannot be cured, although it certainly can be considerably improved. The furthest development, that with absorbed discs and synostosed vertebræ, cannot probably be even improved. But this is very far from saying that such patients should be abandoned to their fate; for though art may not be able to make them better, nature, if left untrammelled to herself, can and does make them worse. By making worse, I mean to indicate that the deformity becomes more and more pronounced; that pressure in false directions and abnormal positions, embarrasses the

functions of thoracic and abdominal viscera, whose untroubled action is necessary to health, even to life (see p. 59). Moreover, the spine, the intercostal spaces, the antero-lateral aspects of the abdomen, and also of the ilia, are often affected with peculiar forms of neuralgia, which become distressing after standing awhile or after any fatigue; such troubles are more marked as the patients lapse into premature age, when great debility is apt to supervene, they totter a good deal, get about with difficulty and even seek some external support while standing. Yet though this is the tendency, it is not the invariable result of the deformity; a certain proportion of such women are strong and sturdy, even though much awry.

The influence of heredity requires some careful study, for we have to consider it in three points of view: 1stly, as to its reality, and if possible its per-cental influence; 2ndly, the curability or otherwise of hereditary scoliosis; 3rdly, the propriety or impropriety of marriage for young women with lateral curvature.

1. Women markedly crooked bring up to maturity, healthy, and perfectly straight children: I have seen many cases in which the daughters of such a woman have been tall and beautifully-shaped girls. The daughter, sometimes more than one daughter, of a finely formed mother, may be

scoliotic. Thus there is great difficulty in asserting that the disease is hereditary; nor have we as yet sufficient insight to know if we should include in the investigations the male side of the parentage or collateral relations; such as the father's or the mother's sisters. If we take, as I think we should, merely the mother's condition, I find heredity in 16·7 per cent. of my cases, inclusive of rickets, which disease is inherited. If we exclude rickets, I can only trace direct heredity from the mother in 5·5 per cent.,* which number is considerably smaller than that usually given, probably because I have included only direct maternal heredity. Yet if we take the highest statistic, Eulenburg, twenty-five per cent., it follows that lateral curvature is three times more often independent of parental fault than traceable to any such condition. Thus we should have to know how many child-bearing women in every thousand are scoliotic before any statistic can be sound. For the problem stands thus: to set up a true statistic we must know: a , the number of scoliotic children born of scoliotic mothers; b , the number of straight children born of scoliotic mothers; c , the number of

* These numbers differ widely from those of some other observers. Eulenburg, "Zur Aetiologie der habituellen Skoliose," 'Berliner Klinischer Wochensch.' 1865, Nr. 18, traces heredity in 25 per cent.

scoliotic children and the number of straight children born of straight mothers. Such inquisitorial investigation as this is barely possible, and, in fact, we never are called upon to investigate in this sense, still less to number the straight progeny, whether of crooked or of well-formed mothers.

Probably the influence of heredity is limited as follows: A strong woman with lateral curvature in the first or earlier part of the second degree, whose health is good, will have children as little liable, or not perceptibly more liable to scoliosis than are the offspring of a straight woman. But if child-bearing be rapidly recurrent, more especially if such rapid recurrency cause loss of health and induce a relapse of increasing deformity, the children born of a woman in such state are more likely to become scoliotic than are the children of healthy mothers. And the children thus born of relapsed mothers will probably account for the percentage of inherited scoliosis.

2. The question as to whether the crooked child of a scoliotic mother is less curable than an equally deformed child of a straight mother must, I think, be answered in the affirmative, if by less curable we understand, not that they are incurable, but that greater and more strenuous efforts, with more constant supervision, must be used. Children born under the circumstances, detailed in the last part of

the previous paragraph, are liable to lateral curvature, because of the soft condition of their bones. The cartilages, large in proportion to the osseous nucleus, are hyperæmic and proliferating, while the deposit and organisation of osseous granules are delayed. This condition favours the influence on the growing vertebræ of any unilateral pressure, or of any faulty position, but also, at the same time, the action of any real remedial measures. Also it is to be noted that the children of a scoliotic parent are generally watched with greater solicitude, in this point of view, than are the offspring of straight mothers, and that they therefore as a rule come under earlier treatment.

3. The surgeon is not unfrequently asked if a young woman, whom he may be treating or may have formerly treated, should be allowed to marry. The question is usually put with a view of eliciting whether or no the deformity, by altering the shape of the pelvis, may render parturition dangerous. The answer to a question thus formulated is this : unless the deformity be extreme, or unless a slighter amount of distortion have originated in rickets, the form and the outlet of the pelvis are not altered sufficiently to interfere with expulsion of the fœtus ; and even very marked deformity, if it be primarily dorsal, may coexist with a nearly or perfectly normal pelvic outlet. But we ought to look

somewhat further than the mere safety of the parturient mother, viz. to the effect on her of one or several births, and on the probable well-being of the progeny. Women, who are greatly deformed, are sometimes asked in marriage, and some of them even have large families without any depreciation of health ; and though this is, I conceive, somewhat exceptional, yet it is frequent enough to leave us no warranty to forbid marriage, especially if the deformity be not in the lower segment of the spine—the same reasoning applies with greater force when slighter degrees of crookedness are in question. But the state of the general health is of importance, as great as the condition of the spine. For a feeble, anæmic, scoliotic woman is unlikely to bear several children without relapse ; while a strong though crooked woman may do so. Moreover, the offspring of the former will, in all probability, be deformed. These points will afford foundation for a prudent answer.

CHAPTER IV.

CAUSES OF PRIMARY LUMBAR CURVATURE.

WE may now, by the aid of the principles laid down in the previous chapters, examine the origin and causes of lateral curvature. It is better to begin with lumbar curves, because their etiology is more simple.

Let me recall certain points that were stated in the commencement of last chapter. Firstly, that in its inception lateral curvature is a mere posture, not at all exaggerated in degree, but only abnormal in its persistence. Secondly, I must refer to what was said concerning the flexibility of the spine, about the manner in which it, more especially its lumbar division, bends to right and left in walking, riding, etc., and to the special experiment of seating a subject on a board which so rocks laterally as to raise each side of the pelvis alternately. Let it also be remembered, that if this rocking motion be checked at a moment when the board, and with it, of course, the pelvis slopes considerably, the curve of the spine persists as long as that obliquity remains.

But there are many causes infinitely more

frequent than sitting on a see-saw, which may impose upon the pelvis of a young person, an oblique position. We may take as an instance the result of a former hip-disease, or, better still, some inequality in the length of the lower limbs. Such unevenness of growth is very frequent, its causes very various ; it may have been produced by a blow or fall in early childhood, which, producing no immediate result, was hardly noticed, has long since been forgotten, but which, nevertheless, has retarded growth at one of the epiphysal junctions, either of the femur, tibia, or both. The same retardation may have been caused by a more or less transient attack of infantile paralysis, or of epiphysitis. Occasionally the difference is not produced by diminished but by increased growth of one limb. Hyperæmia and hyperplasia about the joint end of a bone not unfrequently follows an injury or accompanies a slight inflammation. Often the history, cross-question as one may, fails to include any such causality, and it may be permitted to ascribe the inequality to some primordial difference in the division between somato-pleure and splanchno-pleure, out of which groove the original limb-buds sprout. We know in reality but little of this last condition ; it is, however, analogous to that which causes the features of some persons to be a little awry, or rather, I would say, which causes the

features on each side of the face to lie, in most people, just a little out of perfect and insipid symmetry. Whichever of these conditions may be the cause, in any one case, the effect is the same, viz. that when the subject stands erect, one side of the pelvis lies lower than the other; its transverse axis is oblique.

This obliquity influences the spine as follows: the upper end of the sacrum is no longer in the middle line of the body, for the point upon the pelvis turns while the patient is standing, is one or other of the acetabula—the line connecting these two cavities is about on a level with the lower end of the sacrum; therefore, when the pelvis slopes, that end of the bone forms, as it were, the pivot on which the higher portions move—towards that side, of course, on which the crest of the ilium lies lowest. In other words, the true middle line falls on the lower end of the sacrum, its body and upper end sloping away to one side of it. More important still is the fact, that the upper surface of the bone, that on which the lumbar spine stands as on a foundation, is on the slope. The last lumbar vertebra has the lower part of its body so shaped that its axis must lie in a right line with that of the sacrum; * but the rest of the column cannot follow

* Until the latter phases of curvature are reached, when the bone in question may become very much altered in shape.

74 *LATERAL CURVATURE OF THE SPINE.*

this line, because it is impossible to stand with the whole trunk slanting (not bending) to one side. Thus the whole body is thrown over to the higher side of the pelvis, a manœuvre which is effected by



FIG. II.—Permanent Pelvis Obliquity.

bending the lumbar spine pretty sharply, with the convexity looking towards the side on which the pelvis is lower. For some considerable but indefinite time this curve is, as already stated, a mere

position ; neither ligaments nor bones are changed, as is evident from the fact that any means which will restore to the transverse axis of the pelvis its proper horizonticity will also restore to the spine its normal rectitude.

The outline, taken very accurately from a photograph, illustrates the former proposition. The figure is that of a lad, fourteen years old, who, at about two years old, suffered from an attack of infantile paralysis, which almost entirely passed off, but left certain muscles weak and others contracted ; this latter condition I have remedied, but no art can overcome the resultant deficiency of growth ; the left leg is a little more than two inches shorter than the right, and as a consequence the crest of the right ilium lies very considerably (about two inches) higher than that of the left, or, in other words, the transverse axis of the pelvis is very oblique. Therefore, the lumbar spine curves to the left ; but the curve has been prevented from becoming "fixed," by the care and vigilance of which, under my directions, this boy has been the object for a considerable time. It has not been allowed to affect the shape of the bones nor even the tension of ligaments. The deformity has been kept in the stage of mere posture, forced upon the spine by the position of pelvis. This is demonstrated by the effect produced on this same boy by placing

76 *LATERAL CURVATURE OF THE SPINE.*

under the left foot a block sufficient to compensate for the shortness of the lower limb (two inches), thus rendering the pelvis horizontal, under which

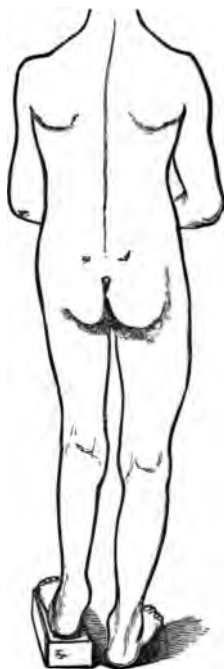


FIG. 12.—Obliquity Annulled.

condition the posture of the spine is changed ; it becomes quite straight.

This sort of oblique position of pelvis caused by some such condition as unevenness in limb-length,

by a joint anchylosed in a bent position or by any other defect which is constant in its action and results, I have named "permanent pelvic obliquity." It is not my intention to affirm that such condition must of necessity last the whole of life—some of these states may be cured—others, such as mere apparently causeless uneven growth may, indeed often does, in the course of years rectify itself, but while they last they are constant or permanent factors, not varying within brief periods of days, weeks or even of months.

Another cause of a sloping pelvis, I have named "habitual pelvic obliquity," it is the result of a trick, hence frequently varies, although it is sufficiently constant often to produce decided lumbar curve. Many girls acquire the bad habit of standing constantly, or at least very frequently, on one and the same leg, generally the right, and of bringing the other thigh and knee in front of the supporting limb with very considerable adduction and some inward rotation. The attitude is, as I have said, very frequent with girls from about the age of thirteen or fourteen upward to twenty-three or twenty-five. A large proportion of those addicted to this attitude are troubled with too frequent and copious catamenia and many have pain and tenderness in the region of the ovary, usually of the left one, in others no such troubles exist. It would

78 *LATERAL CURVATURE OF THE SPINE.*

therefore be improper to say that habitual pelvic obliquity is due to ovaralgia or chronic ovaritis, if we take this phrase to mean direct and constant

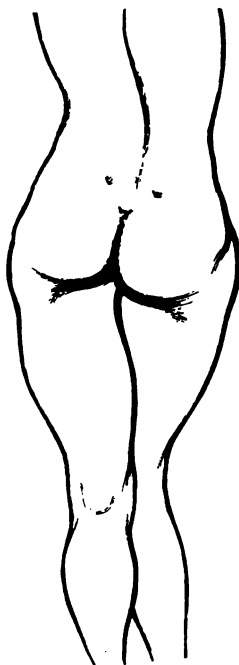


FIG. 13.—Habitual Pelvic Obliquity.

causation ; at the same time I have seen a great number of cases in which the position of the lower limb and pelvis here shown was concomitant with

such disturbance in the pelvic organs ; moreover, a goodly proportion of such patients have told me, in response to questions, that the posture procured a certain alleviation of the sense of weight and aching at the groin. With the majority of patients, however, the position is a mere trick, which would not injuriously affect the spine if the side were varied, if, that is to say, the body were supported equally often on the right and on the left limb ; such is however not the case ; as a rule, the girl stands always or nearly always on the same leg—the mode and pattern of female dress concealing the fault, which the male youth in trousers or knickerbockers would be laughed out of in a week or so.

Such pelvic obliquity is a very frequent cause of lumbar curvature, and as my practice is so largely occupied in the treatment of joint disease, I have frequently had occasion to observe how a limb, shortening by diminished growth, while the other continues its normal progress, influences the horizonticity of the pelvis, and thereby produces curvature of the spine.

CASE I.—Florence H., aged 12 years and 8 months, was brought to me 7th of December, 1887. About 7 years ago the child was observed suddenly to go lame, more especially after any walk a little longer than usual. The neighbourhood of the right hip was painted with iodine, and she was ordered to rest, and was better ; but any little extra fatigue

brought back limping, and complaints of dull pain ; sometimes these returned without apparent cause.

I found the child to be fairly plump and strong, but rather pale and with a worn expression. On examining for hip disease, I found doubtful or, at all events, very slight apparent lengthening of the right limb. At the upper part below the antero-inferior spine of the ilium, in front therefore of the neck of the thigh-bone, a swelling about two inches long by one broad, tender on pressure, obscurely or very deeply fluctuating. All movements of the hip-joint free and painless. She was said to be very lame after walking a little and to suffer much pain. She had no starting of the limb at night, nor any nocturnal pain. I diagnosed an *ostitis* at the upper and outer part of the femoral diaphysis.

By very careful management further evil was not merely avoided, but she greatly improved, and on 9th May, 1888, it is noted that the child is very healthy-looking, has no pain, and has grown a good deal. The tumour has nearly disappeared ; fluctuation in it very doubtful, but the limb is $\frac{1}{2}$ inch shorter than the other from lack of growth. There is in consequence, while standing erect, a slight curve to the right of the lumbar spine.

August 28th.—The right limb is fully $\frac{3}{4}$ inch shorter, and the curvature, when she stands upright without the heightened boot, has increased ; but a block under the right foot straightens the spine.

Case under treatment and improving.

I might mention many other such cases, but though the particular initial trouble varies, the history of the advent of curve would be a monotonous repetition of similar events.

But there is still another malposture of the pelvis

and lower limbs which has not hitherto been observed by any surgeon, and which the use of an instrument shortly to be described, has enabled me to discover. When that mechanism was placed in position against the back of some patients, it was remarked that in a great many the pelvis lay to one side. I do not mean that it is in such cases oblique, it may or may not be so, but such obliquity has apparently nothing to do with the posture, I am now endeavouring to explain, which is a total and bodily shifting over of the pelvis (oblique or horizontal) to one side, viz. to the left in the ordinary form of curve. This amesial condition may, as I shall show hereafter,* amount to an inch or more. Such position of pelvis connotes of course that the lower limbs are out of the perpendicular, that in fact traced from the heels to the hips they slope to the left. It appears to me that this peculiarity has escaped notice because of a natural dislike both on surgeons' and patients' part to stripping the whole figure; but my instrument pointed out to me without that unpleasant expedient this condition of things. Nor was I satisfied with the indication thus afforded: the entire novelty of the subject, and the fact that my gauge was also new, produced in my mind a certain scepticism. I

* The reader is referred to p. 113.

therefore always dropped a plumb-line from the lower part of the rima natium to within half an inch of the floor, and invariably found, that when my gauge gave this indication, the lead did not fall between the heels but in the ordinary curve (lumbar to left, dorsal to right), entirely within the area of the left heel, sometimes outside its middle, sometimes, though more rarely, altogether outside the left foot. I shall, however, only refer to this condition of pelvis in the present place ; because, although it not unfrequently accompanies lumbar, yet it is more usual in dorsal curvature. In whichever form it appears it is a very important factor, partly in connection with causation, but chiefly with regard to diagnosis and treatment.

The sort of curvature produced by an oblique, and also by an amesial pelvis, originates in the necessity of balance and has been called, especially by German writers, a "static curve," those same writers denying to muscular action any part whatever in the production of scoliosis. By the necessity of balance, I mean that when the pelvis is thus displaced the centre of gravity must be shifted over to one side, in order to maintain the body on its narrow resting-place, the feet. This, however, is only a portion of the truth, for the impassive bones have of themselves no power of moving or changing their position ; they are, on

the contrary, moved so as to shift the centre of gravity by muscular force. Hence, though the remoter causes of the so-called static curve are certain malpostures of the pelvis, yet that force which bends the spine laterally into a position of equilibrium is and can only be muscular. Therefore all the above described curvatures are due immediately to muscular action.

We have yet to consider, although the subject will be more fully discussed in the ensuing chapter, another, and perhaps as potent a causation, which influences the spine during sitting, more especially during the many hours of study to which nowadays both girls and boys are subjected. A very large part of the present education is carried on by writing: the student writes out grammar, conjugations, history, geography, mathematical problems, &c. &c. An industrious pupil is therefore often at the desk five or six hours a day, for five or five and a half days in the week; and more often than not in an injurious posture—especially so if she be at all short-sighted, or if her table be in an ill-lit part of the room. Several faulty postures and several degrees of the same fault are by different scholars assumed. One of the more common is to sit chiefly on the left buttock and to place the paper close to the edge of the table just by the right side of the chest, often to twist the

right foot round the leg of the chair, and then, leaning upon the left hand and arm, brought close to the paper, to bend and screw the upper part of the figure over to the right with that side of the chest in front of the other, thus producing again, by muscular acts, a twist and curve of the lumbar spine, which after a certain time becomes fixed as a morbid curve.*

Thus we come to the conclusion that lateral curvature, primarily lumbar, is the result of certain relative positions of pelvis and trunk produced by various causes. The question naturally arises whether these conditions account for all the cases. I believe not for quite all ; yet, except for a small percentage, originating in circumstances shortly to be given, I have very rarely failed to detect, when the pelvis has been straight and mesial, certain bad habits of writing, certain awkward tricks in standing and sitting, which sufficiently accounted for the curve. Among the small percentage are cases due to rheumatic or renal disease, occasionally to some uterine or ovarian disturbance. An attack of acute or sub-acute rheumatism may affect the lumbar muscles alone, or may, after recovery of other parts, linger in those organs, producing pain and contraction,

* This subject is fully discussed in the ensuing chapter, meantime the reader is referred to Figs. 15, 16, pp. 106-8.

CASE II.—I was asked, 2nd January, 1889, by Dr. Thomas, of Wandsworth Common, to see Miss M., aged 17, large and strong for that age; but until 13 was short; between that age and 15 grew very rapidly. In July, 1887, she was exposed to weather, got very wet, more especially about the loins, and was laid up for a fortnight with lumbago, from which she recovered apparently completely, except that her mother noticed she stood and sat a good deal on one side. On the 21st of December, after driving in an open carriage, she had facial paralysis, and soon after began to complain of severe pain in the loins. This got a little better, but as the crooked condition of the back increased, I was called in. I found her in bed, and as long as she was recumbent was in no pain; but the lumbar muscles on the left of the spine were tender: Temp. normal, pulse 108. Urine somewhat too acid; no sediment. When she was placed on her face, I found that the lumbar spine curved considerably to the left. She tried but could not stand erect without support. The spine curved sharply to the left, and the pelvis was a good deal twisted. She complained of tenderness over the erector spinæ on the left side of the loins and on the side of the right ilium. She suffered from sleeplessness. She was treated for myositis with alkalies, iodide of potash, and when necessary with small subcutaneous injections of morphia. She got gradually free of the pains, and when Dr. Thomas brought her to my house I was able to take these measurements. At second lumbar vertebra rotation to left, 7° ; lateral deviation, 0.6 inch; at seventh dorsal vertebra rotation to right, 15° ; lateral deviation, 1.2. The pelvis was markedly amesial, the plumb-line falling on outer margin of right heel.*

Renal disease—be it merely nephralgia, or be it

* The rest of this interesting case is given in Chapter XI.

nephrolithiasis, may produce lumbar curvature, more especially in the female sex and in those of nervous delicate habit. I have twice seen this sequence of events, but I have frequently sought for curvature in vain, when kidney stone has been suspected to be present. The production of lumbar curve as a sequel of kidney troubles depends upon the amount of implication of the renal plexus and on the transference of irritation thence to muscular nerves.

Ovaralgia, or indeed any disturbance of the female generative organs, productive of pain, is not an unfrequent cause of lumbar curvature. Any such curve commencing after puberty should cause the surgeon to elicit information concerning the healthy or unhealthy character of the catamenia, &c., and some treatment, not by any means necessarily local or mechanical, may be desirable. Most of these patients suffer from excessive, too frequent and too prolonged menstruation, with painful symptoms usually at the commencement of the period. I have, however, known severe dysmenorrhœa or amenorrhœa to be the condition apparently causing, certainly accompanying lumbar curvature.

CHAPTER V.

CAUSE OF DORSAL CURVE.

THE lumbar curve arising from oblique or amesial pelvis, or merely from an awkward posture in standing or sitting, is the simplest and most easily comprehensible type of a posture curvature. The idea naturally arises that some analogous conditions may be the cause, or at least chief cause of curvature, primarily dorsal. But we are at the outset met by two circumstances somewhat antagonistic to such notion—viz., by evidence that curves in that higher region of the column are often due to other causes and that there is not in early life so frequent and such strong incentive to deflect the upper portion of the spine. Thus since the subject first attracted close attention a great many theories of its causation, some quite untenable, have been promulgated, so that there are at the present day, a host of such, the greater number of which must now be decently buried. Nor need it excite surprise that so many erroneous views have been held ; for opportunities of anato-

mical examination hardly ever occur just at the moment when a curvature is beginning; even when such opportunity does arise, no disease is discoverable, only a position, which probably death and recumbency may annul. Thus the investigator finds something to record only when specific changes in size or shape have taken place, and as these are later phenomena, he is then reduced to estimate or speculate on the causes that may have produced those changes, and, like geologists accounting for the upheaval of mountains, or for depression forming the beds of seas, he may well lose himself among a host of more or less plausible conjectures. To mention all these, would serve no useful purpose; but of this I am certain, that it is just now too much the fashion to insist on one, and one cause only, as the sole producer of dorsal curve; while the more my pretty wide practice extends the more sure I am that there are several. One very general supposition I must, however, combat, the idea of a normal lateral deviation to the right, which was first propounded by Sabatier in a sequel to the third volume of his work on Anatomy. He says that "in the neighbourhood of the second bend of the aorta, about the level of the third dorsal vertebra, the spinal column presents a curvature (concavity to the left) more or less evident in some subjects, in

others only marked by a slight flattening. The curve generally extends from the third to the eighth or ninth vertebra, and is produced by the pressure of the aorta." He, however, expressly states that in many subjects he has not found this curve, and that it appears to occur only in those who in childhood had been weak and delicate. This curve, he believes, explains why so many cases of dorsal scoliosis are convex to the right.* Guided by the indication in the last sentence, this description was seized upon, as affording a long-sought-for explanation of dorsal curvature, yet the sinister course of the aorta was by many not considered the efficient cause of this so-called normal deviation. Some, for instance, Struthers, ascribed it, and dorsal curvature generally, to the asymmetrical position of the thoracic and abdominal viscera.† Others, and among whom Busch is the most noteworthy, thought that the greater use of the right arm was the efficient cause.‡

Whatever view they may take of its causation,

* 'Mémoire sur la situation des gros vaisseaux à la suite de l'Anatomie de Sabatier,' tome iii. p. 406.

† 'Anatomical and Physiological Memoirs,' p. 47, 1854, pointing out that those of the left weigh 15 ounces more than those of the right side. Von Bühring considered it accounted for by the pulsation of the heart. ('Die seitliche Rückgratsverkrümmungen,' &c., 1851.

‡ Loc. cit., p. 131.

most writers seem to entertain no doubt of the existence of a physiological curve, and speak, indeed, with far more assurance than did Sabatier himself, nor have they taken notice (with one exception) of a most important word in his description, namely flattening (*aplatissement*) of one side of the bodies. This exception is Bouvier, who, writing in 1858, makes certain observations so important that they must be here reproduced:—

“I took up the subject a score years ago, and, in a not yet published work, studied this curvature of the spine in a new point of view.

“Firstly, its existence is more general in the adult than Sabatier believed, particularly if those cases in which it is only represented by a sort of flattening of one side of the spine, be taken into account, as he himself seems to have done. One hardly finds one case in a hundred, beyond twenty years old, in which the spine is perfectly symmetrical on the left and right sides, but under that age it is otherwise. The nearer to the time of birth, the more instances of complete rectitude will be found, and one sees no curvature in very young children, not at least unless they bear traces of rickets.”

After some observations, to be quoted hereafter, the author goes on to say:—

“What, then, is in truth this lateral flattening, already mentioned by Sabatier, and constituting

the first stage of curvature? It is a change in the symmetry of the vertebræ which precedes even curvature properly so-called."*

Volkman particularizes this so-called normal curvature more closely, he says: "After the seventh year the dorsal portion of the vertebral column begins, almost without exception, to bend itself a little to the right, and to this bend are added little compensatory curves of the lumbar and cervical region in the opposite direction.†

It is very hard to have to differ from such authorities, more especially from the last, but I must say that his assertions, especially the latter ones, go quite beyond what is demonstrable—at all events, one would like to possess, by way of substantiation, some account of his mode of mensuration, or at least of observation.

I next take the averment of Mr. William Adams, who says: "In the course of my experience in making post-mortem examinations during the twelve years, from 1842 to 1854, that I filled the office of Demonstrator of Morbid Anatomy at St. Thomas's Hospital, I habitually examined the spine after eviscerating the body, and remarked the

* 'Leçons cliniques sur les Maladies chroniques de l'appareil locomoteur,' pp. 373, 375.

† Pitha-Billroths, 'Handb. der Allgem. und Spec. Chirurg.' Vol. ii., Abth. 2, p. 703.

great rarity instead of the frequency of any lateral deviation."* Of course such an assertion must claim every consideration; yet I fear it cannot possess great weight, firstly, because it is merely a contradiction of such authorities in anatomical examination, as Sabatier, Bouvier, Busch, Volkmann and others, and secondly, because there is, most certainly in a great many eviscerated bodies, an appearance of a deviation to the right; but I never saw, nor could I, with the utmost care, ever find (save in subjects affected with distinctly morbid curves) any, even the slightest suspicion of a compensatory and contrary curve in the regions above and below the central dorsal where this appearance is to be found.

During a large portion of my connection with the Charing Cross Hospital, I have taken every available opportunity of examining this matter in eviscerated bodies; for it must be noted that this supposed physiological curve is far too slight to be detected during life by any deviation of the spinous processes or of other parts. For nine years, from 1875 to 1883, inclusive, I took notes of every investigation. They were burnt in a fire that occurred in my then residence and that destroyed most of the papers that were kept in that room.

* 'Lectures on the Pathol., &c., of Curvature,' &c., p. 17.

The outcome, however, was this: 1, a certain number were of scoliotic people, known during life to be deformed; 2, a certain number were found in the post-mortem room to be deformed, without any traceable knowledge of such during life, deformed, that is to say, to a degree far beyond the supposed physiological curve; 3, a goodly number were perfectly straight; 4, the spines of a certain number appeared to deviate to the right in the way described by Sabatier and Bouvier. Now I cannot, for reasons above stated, give actually reliable numbers for each of these categories; but I had just taken out, and had been looking over all my notes on the evening of the fire and am sure that I am not far wrong in saying that they related to 480 subjects, among these were three belonging to the first and second category, say 0.7 per cent. of spines plainly and undoubtedly deformed. Concerning the other numbers, my memory serves me better, and I think I may say almost with certainty that there were 177 bodies, or 36.8 per cent. perfectly straight, and close upon 300, that is to say, just 62.5 per cent. in which an appearance of deviation existed.* Whenever such condition was detected, I always, unless prevented by pressing avocations,

* The bodies of infants under five years old were not taken into account.

dissected clean the bodies of the vertebræ as far back as the insertion of the ribs. When this was done I nearly always found that the appearance of a lateral bend was still more marked than before dissection; but on more rigid examination, I ascertained this to be produced by that flattening (*aplatissement*) to which both Sabatier and Bouvier allude, and indeed I take it, that in his description the latter has given what he more than suspected to be the true explanation of this supposed physiological curve. For I found that the eye looking from full front at a column thus cleaned, naturally takes the most prominent part of each body to be the centre of the bone, as of course it is when the vertebræ are quite symmetrical.

The eye is herein, therefore, an untrustworthy guide; for if with the tips of each index the sides of the apparently deviating vertebral bodies be felt, they will be found perceptibly flatter on the left than on the right. A certain portion of the substance on the left side seems to be missing, to have been worn or absorbed away. Now the bodies of the dorsal vertebræ from the second to the tenth (in some subjects only to the ninth) inclusive, are more triangular in form than in any other region of the column; each one culminates forward in a rounded corner, which, when the bones are superposed on each other, as in life, form in the

fore-front of the spine a blunt crest, and is that which the eye follows, when tracing in the eviscerated subject the rectitude or otherwise of the spine. But the flattening down of the left side of the vertebral body removes that rounded corner a little away from the median line towards the right; the ridge, therefore, which, as above

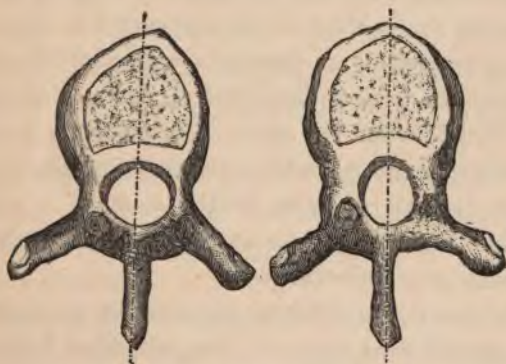


FIG. 14.—Normal and Flattened Vertebrae.

explained, is the line followed by the eye, lies to the right of the middle line; hence, the spine appears, but only appears, to be convex in that direction. In three cases of marked physiological curve (?) I had the fifth and sixth vertebrae removed, and found this flattening in all, and *no other marks of deformity*, the openings for the basic veins were central. The shape of one of these

vertebræ in contrast to that of a symmetrical one is given in the figure. I would then without fear of error affirm firstly, that in a large number of adult bodies, eviscerated and examined from the front, there is an appearance of lateral curve to the right ; secondly, that in such cases, the appearance is deceptive, being produced by a flattening of the left side of the bone ; thirdly, that if a more pronounced curve be found than can be accounted for, by such cause, or even by an unusual amount of flattening, such curve is not physiological, but pathological, and that if, when the most deviated bones in such cases are removed, other abnormities are to be found (unless, perhaps, in the case of a young subject chancing to die at the commencement of a developing curvature).

But can the position of the aorta be accepted as the one efficient cause of this left-sided flattening of the vertebral bodies, which has been so widely mistaken for a deviation of those bones? The theory is very simple and plausible, but certain facts are against it. Bouvier, for instance, says : "The concavity of the curve is sometimes turned to the right ; this peculiarity has been observed in cases of inversion of the viscera, the aorta being itself on the right of the spine. M. Grisolle some time ago communicated to the *Société Anatomique* two cases of this description, MM. Petrequin,

Desruelles and Brechin, have since then published four fresh instances and there are others. Nevertheless, this coincidence is not constant, Beclard saw the spinal concavity to the right although the aorta was on that side.* In a case noted by M. Desruelles, there was no arch of the aorta, and yet the normal curvature was in its usual direction. At other times, while the aorta maintains its normal relations, the curve is to the left, Beclard observed this in a left-handed subject, I myself have seen similar instances, but the subjects were not all left-handed." †

The only possible conclusion is, that neither the position of the aorta nor right-handedness is essential to this flattening on the left side of the vertebral bodies.

The causation of that condition is, however, of less importance than its supposed consequence. Both Sabatier and Bouvier consider it to be the direct cause of right dorsal curvature, by producing a certain left-sided weakness of the spine; the latter, however, insists strongly on the fact, that

* Scheele has comparatively recently published two instances of transposition of the viscera. In one there was no deviation of the spine, in the other the column deviated to the left. (*Berliner klinische Wochenschr.*, 1875, pp. 29, 30.) Author's note.

† Loc. cit., p. 374.

this appearance is not to be found in quite young people, that is to say, at the age when curves commence.

I have dilated at greater length than I otherwise should have done on this point, because I constantly see in practice disastrous results from too strong a belief in the existence of a "physiological" curve; it may therefore be permitted me to point out that, even as accepted and described by its most ardent partisans, such curve is never sufficient to give the slightest external indication in the living body; yet it constantly happens that patients very considerably deformed, come to me with the history that such or such a surgeon had, one, two or more years ago, assured the mother that her daughter "would grow out of it," "and that everybody has, and ought to have a certain curve." Only at the beginning of the present year, a disastrously deformed child was brought, whose parents had been thus told by a surgeon, whose high position and extensive experience should have counselled him better.

We must then put this idea of a physiological curve aside, and consider rather how and at what periods of life morbid curves commence. The congenital curvature, as it is very exceptional, may be omitted for the present; yet we find by no means unfrequently very early scoliosis, originating

probably between the sixth month and the second year of viable life ; though usually discovered rather later, say between the second and sixth year, in carefully tended, much later in the less watched children. Another chief period of commencement is, shortly after the seventh year, and a third from fourteen up to twenty years old. In all these cases it must be remembered, that the period of first discovery is by a certain interval behind the time of causation, even of first appearance. A fourth set of cases must also be mentioned, viz. those that are produced by inflammatory disease within the chest—pneumonia, pleurisy, empyema, which, of course, may begin at any period of life.

The three chief periods of deformation correspond with certain phases of child-life ; the first the infantile, with pretty rapid growth and of great dependence on external support. A baby, as soon as it is able to sit at all, is constantly carried on the nurse's left arm. I have been for many years past, vainly watching in friends' houses and in the streets for some one carrying such an infant on the right arm ; but they are without exception carried in one constant and invariable manner. This connotes that the child leans its right side against the bearer's chest, thus curving and twisting the spine always in the same direction. When in the house the nurse takes the child upon her knee, she still keeps

it on her left side (the child's right towards her own body), her knee is rarely, if ever, as high as her hip, therefore, the seat of the child is oblique. Even if the stool on which she may place her foot, does keep her thigh nearly horizontal yet the baby, save in moments of excitement, is sure to seek a leaning-post against her chest, *i.e.* to its right side. I hope it will not sound farcical, to allude to the manner of attending or rather not attending to very young children in perambulators; they are generally put in straight enough, and after being a few minutes in the open air duly go to sleep, leaning their weight against the strap, which, to prevent their tumbling out altogether, passes round the waist, inclining all the upper part of the trunk towards the right. It might at first thought be supposed that such infants would lean in different directions on different days; but this is not so. I am very fond of even little children, so that my eye is always attracted to them, and I have very rarely seen an infant leaning to its left. It may be presumed that this arises from the mode of nursing; an infant soon learns, that when dropping asleep on the nurse's arm, it finds its security on its right side; hence, it instinctively, when sleepy, leans in that direction, and as its slumber becomes deeper, droops over more and more. There are a few nurses, who occasionally put the infant straight, but

it lolls over again almost immediately, so that she does not repeat her Sisyphus task very frequently. The fascinations, too, of shop-windows, of passing acquaintances, &c., constantly distract her attention.

Thus the infant, from six months up to five or six years old, is very much in the habit of leaning its body over to the right. A majority, those who are strong enough to stretch and take free exercise, in the later part of this period, escape without harm, but a certain number suffer. Among this latter class are doubtless some with tendency to rachitic softening of bones ; but, at all events, in the better-to-do classes these are a small minority. I have at the present moment under my care five children, the oldest being five years and eight months, with different forms of dorsal curvature, in whom the shape neither of the head, teeth, nor epiphysal limb-endings gives the slightest indication of rickets, nor are the ribs at all beaded. In my note-book are seven other equally early cases, and of these two are recorded as showing traces of rickets, while a third is put down as doubtful. These are all children of people sufficiently well-to-do, to nourish their children properly. In hospital work, and in Homes for Cripples, the numbers would come out differently, and I am only speaking of the last five years of my practice. But though the children be not rickety, their vertebræ are

still largely cartilaginous, and are growing pretty quickly. Children between one and six years old grow on an average three and a half inches a year, or rather more. It is hardly necessary to describe again what the effect of such one-sided weighting and twisting on a growing bone, and more especially on growing ligaments, must be (see p. 46). To this subject need only be added that I have more especially described the position as leaning over to the right because I can thereby make myself more readily understood. In reality, however, the infant's posture is one that could only be depicted by a very complicated series of phrases ; it consists, although in part, of leaning over, yet in still greater part, of a *twist* of the trunk, by which the left lateral half is thrown forwards, thus the child leans the right side of its own breast against the nurse, and gets the grip of the perambulator strap as much to its front as to its side, and therefore what looks like merely a sideways bend is also torsion and leaning forwards.

The curvatures which commence between the seventh and fifteenth year are somewhat more common than the above, but, like them, may be primarily dorsal or lumbar. At or about the seventh year mere infancy is passing away ; bodily life becomes more independent of external support and mental training begins. Nevertheless, there

are many circumstances in the period now elapsing, which could cause or induce a child to assume such posture as, other things being favourable, will give rise to a lateral curve. When following its own bent in playing and running about, sitting, rolling, or lying on the floor, in every imaginable position, such a child is evidently laying no foundation for the production of a curvature; but after the seventh year of age, it is no longer permitted constantly to live this happy do-nothing life. Like the imprudent monkey, it has learnt to talk; therefore, again, like the monkey, it is made to work, and very soon after going to school its chief work is writing. This subject has been studied with great zeal in Germany and Switzerland, where such institutions, being more immediately under governmental superintendence than here, offer greater facilities for thorough investigation. Thus before me now lies a *brochure* by Dr. Felix Schenk,* who invented an ingenious, if somewhat complicated apparatus for ascertaining the posture of young people while writing. Here can only be quoted a few of his results and opinions. After observing that "thus it has been shown with all desirable exactitude that every school-child has in

* 'Zur Aetiologie der Skoliose,' etc. By Dr. Felix Schenk, Fabrikant Orthopädischer Apparate in Bern, pp. 12, 13.

writing his own peculiar position. Of two hundred scholars one hundred and sixty assumed such a posture that relatively to the pelvis the upper part of the body leaned over to the left, its weight being thrown on the left elbow, sometimes with, sometimes without, a twist of that part of the trunk. Six scholars exhibited, while writing, no lateral bend of the body. The remaining thirty-four leaned the trunk usually a very little towards the right and generally sat very upright, but twisted the body quite strongly to the left. In this posture the right fore-arm appeared to support very little of the body-weight. All these different posture-peculiarities were reflected very plainly in the configuration of the thorax."

"The one hundred and sixty who leant over to the left had all a more or less strongly marked simple C-shaped curve (convexity to the left).

"Those without any inclination to either side were straight, as regards lateral deviation of the spine, and the others (thirty-four) who twisted their bodies to the left and leant over to the right had that form of scoliosis, which we find described everywhere as the usual one—as the true habitual lateral curvature, namely, an S-shaped scoliosis, with particularly well-marked curve to the right in the dorsal region and a correspondingly heightened shoulder.

"According, then, to the outcome of my researches, it is wrong to distinguish this form of lateral curvature as the most usual, for the thirty-four cases thus distorted are confronted by one hundred and sixty C-shaped simple left curvatures" (*scoliosis simplex totalis*).

He then goes on to say, that these postures are assumed in order to avoid supporting any of the body's weight on the right arm so as to leave it free for the movements necessary to the act of writing, and says: "All these movements can only be well fulfilled when the writing arm is not burdened by any part of the weight of the body."

How different is Volkmann, who describes the position of writing school-children thus: "While writing, the right fore-arm and hand, which wields the pen, lies entirely on the table, while only the left hand at most, sometimes merely the fingers, rest upon it. The right shoulder is inclined forwards, the left one thrown back. The anterior surface of the thorax lies oblique to the edge of the table; but in this position the right shoulder lies rather higher than the left. The dorsal spine bends rather strongly to the right and the more strongly, the greater be the weight which the pupil throws on the writing arm." *

* Loc. cit., p. 705.

The difference in description here so strongly marked, only enforces what I have insisted on, that of bad postures in writing ; there are several kinds. One is throwing the weight chiefly on the right tuber ischii, crossing the left arm a good deal over to the right side, to which side also the paper is



FIG. 15.—Child Writing.

placed. The writing arm is but slightly weighted and these children sit, as a rule, square to the table ; they also not unfrequently curl the right foot round the leg of the chair. All, who place themselves in this position, bend the spine (convexity to the left) in one long simple sweep from nape to buttock. It tends to produce lumbar

curve to the left, often but not always prolonged upward throughout the dorsal region.* This is, I believe, the posture which Schenk noticed in one hundred and sixty out of two hundred children examined,† and at all events, I find it to be a very common one; it tends to produce the curve he describes, which, however, is primarily lumbar. The two woodcuts here annexed leave, I am well aware, much to be desired in an artistic point of view; but as I sketched them rapidly from patients actually before me, and as they give with considerable fidelity the action and sway of the figure, I prefer to leave them as they are, lest they should lose their characteristics by elaboration.

Another very common position that children assume is compounded of a forward stoop and a twist of the body, together with a serpentine bending of the spine. In such postures which, however, are not quite as frequently assumed as the previous one, the right shoulder is thrust upward and backward, the left is lower and more forward; but the shoulders vary their position a good deal, according as the child is writing at the top or bottom of the paper. A third, and the most

* For the reasons why the whole spine is not always implicated, see sequel.

† I believe that in Germany the school writing-table is very high, almost as high as the seated child's axilla.

injurious, is to sit with the right side of the pelvis nearer the table than the left, to plant the feet fairly and evenly on the ground, to place the left fore-arm entirely on the table, but to bend the



FIG. 16.
Child Writing.

upper part of the trunk down, to twist it to the left, to stoop the head considerably forwards till it almost rest on the left wrist, as though to look between the paper and the writing fingers. These are the three postures which I have found most usual, both with boys and girls, but some children

assume other bad positions and some sit well and evenly.

Every child, however, who writes in a faulty attitude does not become the subject of lateral (p. 111) curvature, and indeed such cause may seem quite inadequate for the production of so great a deformation as has been described ; but it must be pointed out that this form belongs to two series of curves, to that produced by faulty position, and to that due to over-use of the right arm, by which is not meant, of course, that the very mobile humerus and scapula has power to drag the relatively fixed spine over to its own side ; but every work which requires either much effort or considerable delicacy

and regularity of manipulation must be performed from a steady base. Writing is, to the beginner, just such a task ; therefore, in order to leave the hand and fore-arm free, and at the same time secure in its movements, both the spine and the scapula are fixed. Fixation of the former is most readily attained by curving it towards the working arm, through action at first, of the left erector-spinae muscles. These, however, after a little, become fatigued, and then a further twist by means of the serratus, which is already employed in fixing the scapula, calls into play ligamentous resistance, especially that antagonistic interaction of the intervertebral discs and ligamenta subflava already explained (p. 25). Also while performing the, to him, difficult task of tracing the letters, the child further fixes the shoulder and chest by taking at long intervals deep inspirations and holding the breath as long as it conveniently can, breathing, that is to say, with a forced sigh between each string of pot-hooks ; and be it also remembered, the right lung is bigger than the left. Thus the whole posture—the fixity of right shoulder, the twist of the spine, the retained breath—all bring the right serratus into strong action, drawing the right ribs back in the mode already explained (p. 23). Of course, no muscle can produce such a deformation rapidly or in one or two acts, but the

continuance or frequent repetition of these influences has in due time a very considerable effect. An instance showing the powerful rotary effect of this muscle may here be given :—

CASE III.—Mr. —, aged nineteen, came to me on the 9th of February, 1867, with a far-advanced dorsal curve to the right. He was by no means weakly, but on the contrary muscular, being used to strong exercise, more especially with the dumb-bells. Rotation was very marked, the right ribs and the lower angle of the scapula projecting very much backward ; but there was something very peculiar in the distortion ; it bore, markedly, all the characteristics of a weight-bearing curve, with the exception of a very characteristic feature—the strong development of the left sacro-lumbalis and longissimus dorsi. It is true that he confessed to using the dumb-bells rather more with the right than with the left hand ; but in all my previous cases I had always found such or similar work produce with the curve that muscular elevation. The condition was, to my mind, so anomalous that I re-examined all my minute records, my photographs, and my theory of lateral curvature. On his second visit I observed this peculiarity of attitude : he always stood with the right hand placed far back on the hip or on the loins, and threw his elbow as far back as possible. I kept him with me as long a time as I could spare, and standing as much as possible. He maintained constantly this attitude ; and, on questioning him, I found it was habitual. Thus, then, was my difficulty not only solved, but a singular proof added to my observations on the rotating power of the serratus. This position, by throwing back the base of the scapula, caused that muscle to drag upon the ribs and not only the absence of an extra burden, but the fact of his supporting the weight of the trunk on the right hand, precluded the extra development of the left *erectores spinæ*.

Though an extreme instance, the case is of value, as showing the sensitiveness of the spine to that rotatory power when constant or very frequent.

It must I think be conceded me that I have shown (p. 50) that the shape of the scoliotic vertebra precludes the idea that it turns and drags the rib with it, but that on the contrary it is the rib which takes up a backward movement and rotates the vertebra. Also I have shown that the mere bend of the spine in writing does not account for the predominance of right dorsal and S-shaped curve, Schenk's statistics (p. 104) proving that it tends to produce simple curve to the left. There does not appear to be any theory alternative to that I have enounced. But I change the view ordinarily assumed as to the sequence of events, it is generally believed that rotation is a sequel of lateral deviation, my conviction is that in most instances the deviation is consequent on the rotation.

Yet all young people who write in more or less awkward positions do not acquire scoliosis—those, and among these fortunate ones are the generality of boys, with fairly vigorous muscles, those who after school work set about some athletic play do as a rule escape. But such as are "weedy" and anæmic, quick growing girls who exhibit in well-marked form that inability of muscles to wield the increasing limbs, which confers

on that period of life the name of "awkward age," those whose anxious mothers prohibit the natural desire for rest, that prompts to lolling and to leaning on the elbows—all such girls are very easy victims of deformation. Because the tired muscles of the spine strike work, and hand over to the ligaments the task of upholding the trunk, and this they can only do by such a twist and curve, as tighten the fibrous bands on one or other side of the column, thus probably gaining some support by throwing, in such posture, some of the body-weight on the articulating processes.

The subject having become accustomed to a crooked position, while sitting, cannot without a sense of inconvenience and strain, put the column straight while standing, but when placed in drill posture the examining surgeon will see that the upper, the thoracic part of the trunk, seems shifted over to the right. This condition, not sloping, but apparent displacement, *en masse* to the right is, as we shall see hereafter, one of the chief diagnostic signs of a curve primarily dorsal.

The last sentence represents, doubtless, the condition in some cases, but in others, indeed I think in the large majority, it is not the upper part of the trunk which has moved to the right, but the lower or pelvic portion which has shifted itself to the left. As previously stated, this posture has not

hitherto been observed by any surgeon (p. 81) and therefore it requires some explanation.

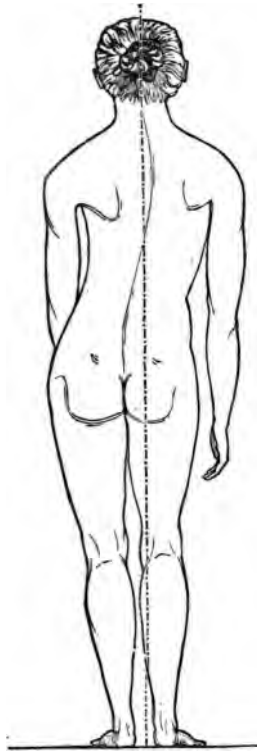


FIG. 17.—Amesial Pelvis. The Vertical Line' has been unfortunately placed a little too much to the right.

The annexed diagram represents such condition, the straight dotted line running from between the

heels to above the vertex is the perpendicular on which all normally central parts of the body, and the space between the lower limbs should lie ; or if the pelvis were mesial and yet there were lateral curve, this line would correspond with the rima natium, and the spine would oscillate from right to left of it. But this is not the case, the line traced from below upward when as in the figure the pelvis is amesial, falls on the right inner hamstring, thigh and buttock all the lumbar and the greater part of the dorsal spine lie to its left—the head is mesial. This, of course, indicates that the lower limbs and lower half of the figure slope to the left, the upper half assumes a displacement—with undulations—to the right.

It cannot surely be expected of me to say whether this position is ever an initial defect and cause of curvature, or whether it stands only in the second rank of causality. To solve such problem demands a longer period of research than I have enjoyed. I know that it is early often, may be found in relatively slight cases, and that such patients are unaware of placing more weight on one foot than on the other. It is this amesial pelvis, which, more than any other part of the posture, gives the appearance of a back shifted to the right. It is not as I have said obliquity, but is more analogous to what a geologist in describing strata would call a fault.

A certain number of curvatures are produced by the habit or necessity of carrying burdens on either arm—the amount of weight being of less importance than the length of time during which it is supported—that is, a heavy weight carried for a few seconds, and on rare occasions, has less influence than a lighter but still notable load carried frequently for long intervals. The greater stress of the burden falls on the glenoid end of the scapula, which is chiefly supported by the serratus ; thus also in these curves, that muscle, with its so often mentioned rotating effect on the ribs, is a large factor in producing the deformity ; but besides this, in order to counterbalance the load by some of the body-weight, the erector spinæ of the opposite side is brought into play, and the dorsal spine is curved towards the side of the burden, so as to bring the column more immediately under the burden.

This is the reason why, in the class of girls or young women who attend hospitals or are inmates of Homes, we find a considerable portion with left dorsal curvature : much of their early life has been employed in carrying their younger brothers and sisters on the left arm.

Also among this class of patients there are a very much larger percentage of rickety cases, than among the well-to-do, and I have noted that most rickety dorsal curves are to the left. Part of the

preponderance to that direction of these curves may be accounted for by this carrying, while very young, of infants; but it appears to me that the rickety tendency to left dorsal curvature is larger than can be thus explained. Also curves of a peculiar and unusual form are generally of rachitic origin, such curves as are low, beginning about the sixth dorsal vertebra, and take a sudden outspring to the left, returning almost as suddenly to the middle line.* Curvatures which chiefly implicate the upper four dorsal and two lower cervical vertebræ are very rare,† and very possibly originate in a slight degree of torticollis which has been neglected.

Any disease of one lung which greatly diminishes its capacity induces lateral curvature. Sometimes, as after empyema or sero-pleuritis, this is merely "cicatricial," due to subsequent contraction of the inflamed parts. But in many cases the curvature begins before the cicatricial contraction, and even while the inflammation is at its height. Also it is to be noted that whether the disease be pleurisy with over-fulness of that side of the chest, or whether it be hepatization with shrinking of the lung—

* The specimen in the Hunterian Museum already referred to is of this sort, and I showed such a case at the Clinical Society, 22nd of March, 1889.

† I have had for years such a case under occasional observation.

therefore emptiness of that side—the curvature is always away from the diseased side. This arises from the fact that on the affected side all the respiratory muscles are thrown out of action, while on the sound side their work is increased ; and the excess of breathing thrown on the sound lung by the defection of the other calls the muscles, adjuvant to respiration, into play. It may be well to observe here that these which we will call pulmonary curves are of the same shape as those we have hitherto considered, namely, the dorsal one ceases at the ninth vertebra which lies on the middle line, the contrary lumbar curve begins below this. Now the last indigitation of the serratus is on the ninth rib,

CHAPTER VI.

THE AUTHOR'S SCOLIOSIS GAUGE.

A LONG desired requirement is a means of measuring lateral curvature, not only in regard to the sideways deviation, but also with regard to rotation, with regard to the relative height of the two sides of the pelvis and of the angles of the scapulæ. It is easy to obtain some approximate measure of the first of these conditions by means of a plumb-line let fall from the vertebra prominens ; but only approximate, because the line lies upon the back in the dorsum and away from it in the loins.

A wire or strip of lead passed part way round the thorax, from which a tracing can afterwards be made, is a very old device ; it does not, however, measure rotation, but only the amount of alteration in the form of the ribs. These simple expedients being recognised as insufficient, many attempts at the construction of some more perfect appliance have been made. Heinecke's pendulum and staff is only a slight improvement, if indeed it be an

improvement on the plumb-line.* A more complete instrument is that of Mickulicz† which consists of an upright made of flexible steel like that with which women's stays are stiffened, and a transverse piece of similar material so attached to the other by means of a brass socket that, while remaining at a right angle, it can be slid up and down; both these are marked in millimetres. The upright ends below in a round staff jointed on to a pad and block, that is secured to the centre of the sacrum by straps passing round the pelvis—the round staff carries an index needle which plays over a goniometer in the block. The two metal staffs being flexible and elastic can be moulded, the upright one to the spine, the horizontal one to the posterior wall of the thorax, while on the goniometer, the inclination and, to a certain degree, the torsion can be read off.

The instrument is faulty, inasmuch as when the pelvis is oblique and when the pad and block are strapped to the back of the sacrum, they also, if they be true, are oblique—the metal upright must fall in the same direction, or if forced into the perpendicular will throw the goniometer out of gear. Moreover, the metal arms, which are

* See Vogt, 'Moderne Orthopädie,' Tab. xi. p. 71.

† Scoliosimeter, "Ein Apparat zur Messung der Scoliose," 'Centralblatt für Chirurgie,' 1883, p. 309.

especially to be made flexible and elastic, lose by that very quality all power of measuring with any accuracy the rotation of the spine.

Schulthess has devised and described* an instrument with which to draw, probably with considerable accuracy, lateral curves. It consists of an oblong perpendicular frame-work, within which the patient stands, on a board adjustable to different heights; to the upright on the patient's right is fixed a frame holding a plate of glass lying on the same plane as the oblong frame-work, while on his left is another similar frame and glass whose plane is at right-angles to the other. Movable up and down and within the area of the uprights is a bar, to which by means of rather complex joints, and a shiftable trellis-work are fixed two rods passing to right and left respectively and bearing at their distal end a pencil, at their proximal end a blunted steel point. When the patient is placed in position, and held there, but not very fixedly, the surgeon traces over with the steel blunt point all the side outlines and other parts of the body which act as a templet, the pencil on the right marking the desirable points, as seen when looking straight at the back, the one on the left, those from above downward. Horizontal curves,

* 'Centralblatt für Orthopädische Chirurgie,' 1887, Nr. 4.

viz. those of rotation, have to be drawn by a re-arrangement of some little complication.

Many objections to this instrument are evident: its costliness and complication, the time necessary to work it—at least half an hour—during which the patient's attitude must surely change; the necessity of re-adjustment for what is the most important part of the measurement—the rotation. When completed there are no less than three figures, and to combine these into one measurement and appraisement of the deformity must be a matter of considerable difficulty and uncertainty.

The instrument has not gained great appreciation in the country of its birth, and is, I think, unknown elsewhere; indeed, Lorenz* rejects all such instruments, declaring that photographic pictures give more accurate results. Here, also, I must however object, that a little different lighting, a darker day, an almost imperceptible change in the relative position of camera and patient, will vitiate the result.

It has long appeared to me that it must be possible to construct an instrument that would measure at one and the same time torsion and lateral deviation, at any or all elevations, also

* 'Pathologie und Therapie der seitlichen Rückgrats Verkrümmungen,' p. 131.

pelvic malpositions, and height of shoulder ; thus at last I devised the one to be described :—

The instrument is of brass and stands upon three nearly horizontal feet, the two hind ones projecting radially from the centre eleven inches, the front one (*a*) is longer, viz. fourteen inches. From their junction at the centre a one inch square tube (*b*) rises perpendicularly one and a half feet. In it slides smoothly and accurately a square rod (*c*), which is fixable by a clump screw. This rod bears atop a horizontal plate (*d*), two inches broad by six long, projecting accurately over the longest of the three supporting feet. At the end of this plate, and at a precise right angle with its long axis, is a rule (*e*), fifteen inches long and divided into inches and tenths. Sliding on each lateral half of the rule inward and outward but fixable by a clamp screw, is a gauge six inches long (*f-f*). The horizontal brass plate has, moreover (*n*), along its long axis, and beneath the exact centre of the rule, a slot which allows a wire to play in it in such wise that it can be thrust outward half an inch or more.

It will, I think, conduce to the comprehension of this instrument, which is really simple, though it seems complex on description, if I first explain how this first or lower part is used. The clothes being all removed from the upper part of the

patient's body, a dot of ink is made on the first and second sacral spine and one at each side outline of the figure on the crest of the ilium—then he is directed to stand with the knees straight and the feet together, and between these latter the longest foot of the instrument is guided till the rule is about two inches from his body surface ; the slide is drawn out until the rule is on a level with the ink-blot on the sacrum ; the little wire is protruded, its end just touched with a freshly dipped pen and again withdrawn. Now the instrument is slid further until the edge of the rule comes in actual contact with the posterior part of the pelvis ; the gauge slides are brought inward and into touch with the sides of the ilium ; the wire is extruded until its contact with the skin makes a little dot where the middle of the sacrum should be, if the pelvis were perfectly straight. The distance of the gauge from the crest of the ilium on each side is measured.* This part of the instrument indicates, therefore, the rectitude or the obliquity of the pelvis and, moreover, measures accurately the degree of what obliquity is present ; it must be remembered that whenever this condition obtains, the first and second sacral spine must be out of the centre, for the whole ridge

* This is most expeditiously done with compasses, the distance between its points being tested by the rule.

slants, its upper end having moved towards the side on which the pelvis is lowest.

An amesial condition or position of the pelvis and lower part of the figure is certainly present in a large proportion of cases. Its detection by means of the scoliosis gauge is as follows: When the instrument is so placed that the lower rule (*e*) is in contact with the pelvis, the surgeon sees if its centre corresponds with the middle line of the sacrum; if not, he depresses the garments enough to expose the upper part of the rima natium; then, placing his eye so as to get slide (*c*) in one line, with the lower part of slide (*g*), he observes if that part of the body lies in this line or to one or the other side.

As yet only a comparatively minor part of the investigating power of this instrument has been explained; the chief portion lies above the horizontal brass plate that bears the fixed rule. Now in this plate, four inches from the edge of the rule, is fixed a socket and a clamp screw. In the socket a third square rod (*g*) plays up and down, being fixable by the screw—the top of the rod bears a horizontal square tube (*h*), which runs in a direction away from that of the longest foot, *i.e.* away from the plane of the patient's back when the instrument is put in position. In this horizontal tube, and also fixable by a clamp screw, runs back

and forth a square rod (*l*), perforated from end to end. At its extremity, nearest the patient, is a horizontal rule (*k*), which rotates glibly and horizontally on a little nut, and from the centre of which runs directly backward, an indicator needle, four inches long, that plays over a graduated sextant of equal radius; moreover, the quite smooth perforation in this rod carries a polished steel wire (*m*), one-quarter inch diameter, which quite fits the channel yet runs easily, and which is filed to a blunt point in front.

The mode of obtaining information from this part of the instrument is as follows: The skin over the middle of the fifth, sixth, and seventh spinous process, is to be marked with a dot by a moistened aniline pencil and the end of the wire is to be touched with ink. Then the instrument being brought into position, as above described, the upper slide is drawn out until the revolving rule is on a level with the sixth dorsal vertebra. Here it is fixed by a turn of the clamp screw, the surgeon then directs the patient to clasp his hands and hold them with the elbows straight over the centre of the hypogastrium, pushes forward the horizontal square rod. If the back be straight, *i.e.* if there be no rotation of vertebræ, the rule as it comes in contact with the posterior thoracic wall remains square to the rod and the indicator rests at zero.

But if there be rotation, *i.e.* if one side of the thorax be on a plane posterior to the other, one end of the rule will be pressed backward, and when the rod has been pushed so far forward that the edge of the rule is in contact with the back, on each side of the spine, the indicator will mark on the sextant the amount of rotation in degrees and fractions. The wire is then pushed out and the spot which it makes on the skin, and which is in the true perpendicular of the figure, will be a certain distance from the pencil-dot made over the spinous process of the deviated vertebra; this distance measured by compass, and checked upon the rule, gives the amount of lateral deviation. The surgeon can then score in his note-book—rotation x degrees; lateral deviations, y decimals of an inch: these notes can be used for future reference in regard to improvement and effect of treatment.

If it be further desired to ascertain the relative level of the scapulæ—the patient is told to let the arms hang down by the sides—the angles of those bones may be touched with the blue pencil—the upper slide drawn to a level of the lower mark the rule is pushed forward and the distance between this and the higher mark measured with the compass.

It is scarcely necessary to add that, although I have for simplicity's sake mentioned only three dorsal vertebræ as the places for measurement, yet

brought to me a few days only after this negation, others in which the denial having lulled suspicion, the deformity has unhappily been allowed to become fully, sometimes disastrously, developed. This detection by parents and attendants, and non-observance by the family attendant, is due to two causes: firstly, to the fact that in their presence the child sits in its accustomed position, or rather in her usual malposture; while, when the doctor comes, she straightens and perks herself up; secondly, because the doctor puts her rightly enough in drill posture before him; but then, as a rule, he does not know what to look for, nor how a back should be examined. I must, therefore, be pardoned if I enter with some little detail into this very important A, B, C, of my subject.

Patients in the infantile stage, or in the quite early part of the second phase of child-life, had better be entirely stripped, even the boots should be removed. The more necessary is it to be very gentle with these little creatures, to gain their full confidence, otherwise terror will quite frustrate any

the time. The young lady had a very advanced degree of curvature, and yet the lady told me that only two years previously she had several times showed the back to her medical attendant (not Dr. Phelps), and he had again and again assured her there was nothing the matter. To use his own phrase, "that she was borrowing trouble."

attempt at examination, or what comes to the same thing, undefined distrust or shyness will cause them to wriggle their flexible bodies, making the real form and condition quite undiscoverable.

In further advanced life, other causes may render patients who have to remove parts of their clothing very fidgety, and then, too, it is most necessary to gain the confidence of the patient and as far as possible to eliminate any sense of shyness that may make her restless and unquiet. Having removed outer clothing and stays, she should be placed with the back to a window—cross lights and misleading shadows being avoided—the hair must be turned up and secured to the back or top of the head, the arms taken out of the chemise and underclothing, which must then be dropped to a level with the trochanters, just exposing the upper end of the *rima natium*. In order to prevent any anxiety as to these parts of the dress falling lower—an anxiety which causes embarrassing movements of both upper and lower limbs—I secure the garments by passing round the pelvis and fixing by hook and eye a narrow ($\frac{3}{4}$ inch) band of elastic webbing. The patient must be enjoined to stand with the feet together and the knees straight, but a mere precept is not enough. The surgeon should pass his hands in front of the knees, outside the remaining clothing, to make sure that his request

has been complied with. He then falls back a step or two, keeping straight behind the middle of the patient's back, which he now regards as a whole.

It must be permitted me to point out to those who are only occasionally called upon to make these examinations, that a very common method and a very general mistake is to at once pass the finger along the line of the spinous processes, and, if it be found not markedly and obviously crooked, to declare that there is no lateral curvature. A vast number of cases have been and are still being overlooked, and their treatment unfortunately postponed, owing to this prevalent error ; for it must be remembered that the direction of rotation (see p. 36) obliterates, as it were, the curvilinear form which the series of spinous processes would otherwise exhibit. Therefore, this row may be quite straight, while, nevertheless, a considerable lateral curvature exists.

No ! in order to detect a curvature, the surgeon firstly directs his attention to all parts of the dorsal aspect except the spine, and should avoid touching the patient until points about to be mentioned have been investigated, such contact being apt to call forth uneasiness, one-sided muscular action and other misleading conditions.

The surgeon should at first study more particularly the side outlines of the figure, and, if he have

before him a case of primary lumbar curve to the left, he will see that this outline is very different on the two sides. On the right (concave side) the upper half of the trunk, which I will call the thoracic segment, has a rather full rounded outline, especially below, where it takes an increased inward direction to meet the outline of the lower half or pelvic segment at a well-marked angle.* From this angle, or what we had better term the incavation of the waist, the line of the pelvic segment runs outward, more or less abruptly and decidedly, according to the severity of the case, whence it follows that what is commonly called the hip, but is of course the crest of the ilium, appears to protrude. The projection is caused in part by the falling away of the soft parts into the concavity of the curved spine, in some cases also by pelvic obliquity.

On the left (convex) the side-outline of the thoracic segment is not only not rounded, it is frequently a hollowed or concave line, which meets the pelvic segment by an outward sweep, not by an angle, so that the boundary between the upper and lower half of the figure is almost obliterated. The prominence of the hip, to use the common term, is effaced; the incavation of the waist has almost

* Rounded off, of course, but always quite perceptible,

disappeared ; what remains of it is part of a long slightly concave line.

On the surface of the back are also differences between the two sides ; on the right, running from



FIG. 19.—A Left Lumbar Curve.

the entering angle between upper and lower halves of the figure, towards the spine, is a depression which marks itself out in a shadow, the lower edge of which corresponds to the crest of the ilium, the upper to the neighbourhood of the last rib. This

depression appears to continue onward towards the middle line, the incavation of the waist. In thin persons one may often see that on the right of the lumbar spinous processes, the parts are less full and rounded than on their left. Both these appearances are due to rotation, the right transverse processes, having moved forward, allow the unsupported soft parts to become depressed. At the earlier period of lumbar curve, when as yet no secondary dorsal curve has arisen, the surface above the tenth dorsal vertebra is symmetrical ; but with this curve a forward stoop (kyphosis) of the dorsal spine is very often combined.

Having observed all this by eye merely, without touching the patient, the surgeon should next investigate the straight or oblique position of the pelvis. In nearly every room there are certain horizontal lines which may be used as guides, such as the edge of a dado or wash-board, the straight side of a table or other piece of furniture. The patient may from the first be placed opposite, though at some distance from, such a line ; the surgeon being behind her places the forefinger of each hand on the crest of the ilium on each side, and by stooping, kneeling, or sitting, as the case may be, gets the horizontal line on a level with one of his fingers and then observes whether the other be also on that level, or whether it be higher or lower. If

either posture obtain, he will find that the lower side is always that of spinal convexity. In some such instances, and in the case of young children, it is unobjectionable to let the garments fall a little lower, in order to observe the direction of the intergluteal fissure, which will be found to slope from below upward and towards the low side of the pelvis ; the sign is not essential to, but is confirmatory of diagnosis.

The surgeon should next proceed to compare by touch the condition of parts on each side of the lumbar spinous processes, and will find that the somewhat depressed, or at least not prominent, part on the right is not exactly flaccid, but is more yielding and softer than the more elevated part on the left. This does not arise from muscular contraction, but from rotation of the vertebræ, which on the left (convex) side brings the transverse processes nearer to the surface, and thereby not only affords a firmer substratum for the muscles, but also brings hard bony parts nearer to the investigating hand. At the same time the transverse processes on the right (concave) sink deeper away from the surface, thus withdrawing their support from the superjacent parts which thus become soft and less resistant.

And now, last of all, the surgeon may feel for the line of the spinous processes. In the less

advanced cases, in which, nevertheless, the asymmetry just described may be perfectly evident, he may not be able to verify any deviation. In other cases, in which the variation between the two sides is a little more strongly marked, the series of spinous processes may be traced as forming a distinct curve.

The above description applies to left lumbar curvature, which is by far the more frequent variety. Nevertheless, a curve to the right is not uncommon, and the same description, reversing the sides, will apply. Nevertheless, and for the sake of rendering that reversal more easy, I subjoin a plate showing lumbar curvature to the right (p. 138).

The diagnosis is now completely made out as far as the existence of lateral curvature is concerned, and as far as the unassisted senses will carry us ; but the degree of rotation, of lateral deviation and of pelvic obliquity has not yet been measured, nor has the presence or absence of amesiality of the pelvis been verified.* The instrument described in

* To measure lateral deviation in the loins by a plumb-line, let fall from the vertebra prominens, is almost impossible, unless the spine have entirely lost its antero-posterior bends, for the line is distant some inches from the skin in that region. In former years I placed my patient opposite a single window or a strong lamp, and used the shadow of the cord as the true perpendicular.

the previous chapter will give all these measurements at once. First the skin over the spinous processes of the two lowest dorsal, the three upper



FIG. 20.—Right Lumbar Curve.

lumbar vertebræ and the two upper spines of the sacrum, should be marked with a dot of the aniline pencil, also the crest of the ilium on each side out-

line of the body, while the patient is in drill posture, and then the long foot of the instrument is slid between the patient's feet until the lower rule is an inch or two from the back; the lower slide is raised until the rule is on a level with the upper part of the sacrum. Both wires are inked at their tips and the instrument is glided still further forwards until the lower rule is in close contact with the skin over the upper part of the sacro-iliac joint and equally so on both sides. The slides are now moved on the lower rule inward until each of them touches the patient. With compasses the distances on each side of the slide, from the pencil-mark on the iliac crest, is measured and checked off on the rule, and the lower wire is protruded until it has marked the skin and is then withdrawn. Now the upper slide (*g*) comes into play; it may be drawn out to the level of the eleventh dorsal vertebra, the wire (*m*) is touched with ink, the horizontal slide is protruded, the marking on the index read off, the wire pushed forward. The slide is let down a little and the same manœuvre (if it be thought desirable) can be practised on the level of every vertebra. When the instrument is removed, the distances between the marks made by the wire (the true perpendicular) and those over the spinous process are to be measured with compasses.

It happens that in some cases of lumbar curve,

though it is more frequent when the dorsal spine is involved, either primarily or secondarily, that the pelvis, which may or may not be oblique, lies altogether on one side of the instrument; the upright of the lower slide does not correspond with the centre of that part, and when the side gauges are brought into contact with the ilia the one may be read off on the rule as being an inch or more further from the centre, marked *a*, than the other. In such cases of amesial pelvis it is well to test the condition by dropping a plumb-line from the rima narium to near the floor. To quite bare the patient is unnecessary; petticoats or chemise can be held by mother or attendant a little away from the figure, so as to leave space for the line to hang free. Investigation as to this point should never be neglected when the instrument indicates the defect.

The surgeon has now all the material for a full note of the case by writing in his note-book the various points measured. He will on the next visit know exactly, if and how much his patient has improved.

CHAPTER VIII.

THE DIAGNOSIS OF RIGHT DORSAL CURVATURE.

RIGHT dorsal Curvature (primary) is as frequent as left lumbar, and like the latter is marked by signs of rotation previous to any change in the line of the spinous processes. To this rotation the ribs act as indices. The surgeon, therefore, examining a patient suspected of spinal curvature, must fix his attention not on the spine itself, but on parts at the side of it. Thus, if the curve be to the right, the shoulder of that side will appear thicker than the other. The complaint commonly made by mothers is that "the girl's shoulder is growing out;" a little further examination reveals the cause of this condition, for, on looking at parts just below and inside the angle of the scapula, they will be seen to lie on a plane posterior to those on the other side; and if the patient be directed to clasp her hands and place them on her head, thus moving the shoulder-blades upwards and outwards, a better view of what looks like a thickening of parts in a line about two to three inches from the spine, will be obtained. This

condition is produced at this stage, not by any change in the form of the ribs, but by rotation of the vertebræ,* whereby the transverse diameter of the thorax, or the general plane of the back at a level with the upper ribs, comes to lie obliquely with the rest of the figure, of the pelvis, for instance (see Fig. 6). On the right the dorsal plane lies too far backward, on the left too far forward.

Now, when the arms are hanging down by the sides the scapula rests on the upper eight ribs, and therefore, when these beds on each side change their relative position, the left scapula sinks, as it were, to the depths with the ribs, and approaches the spine, while, on the right it is thrust backward, and is forced into this peculiar posture. The projection of the back of the ribs is most strongly marked about the seventh and eighth, hence the angle of scapula is thrust more markedly backward than the other parts, and, as it cannot rest on this most protuberant part, it glides further outward or away from the spine. Thus the direction of the dorsum of the bone is changed, as may best be seen by placing the palms of the hand flat on each bone and observing the position of their dorsa; it will then be easily detected, that the right one looks

* The phrase is put thus for the sake of more facile comprehension. In nearly all cases it is more correct to say that the right ribs being thrown back rotate the vertebræ.

in a direction abnormally upward and outward the left one too directly backward; in a severe case also a little inward. Also, and in consequence of these changes, the right bone rises and lies a little higher on the thorax* and with it the acromial end of the scapula is raised, making what in common parlance is called a "high shoulder."



FIG. 21—Dorsal Curve, very early stage.

It is difficult to see slight degrees of this backward projection of the shoulder when the light from a window on the same level falls full on the patient's back. But if it be possible to place her under a sky-light so that the light falls

* This is best tested by my scoliosis gauge.

perpendicularly from above, the right projecting shoulder receives a strong ray on its upper surface and throws down, often as far as the ilium, a considerable shadow on the posterior chest-wall of that side (convex), while on the left that part is in light or half-light, as I pointed out in 1877.

Great assistance may also be obtained in recognising these effects of rotation, as I was the first to point out, by standing on one side of the patient and bending the head over so as to look with one eye down the back, as one looks along a gun barrel. The eye should be on a level higher than the vertebra prominens, and of course, if the patient be too tall, the surgeon may mount on a footstool. Thus looking down the spine, he is to fix his attention, not so much on the spinous processes as on the parts to right and left, comparing one with the other at different levels, which he can command by moving his head nearer to or further from the patient. He will then be able to estimate the relative distance, on each side of the base, of the scapula from the spinous process; the relative protuberance of parts between those points of bone and the amount of backward projection of the whole right side. When, about twelve years ago, I drew attention to this mode of examination, I made careful outlines, of patients thus looked down upon. The diagrams annexed are taken from those drawings.

The upper one is from a symmetrical figure, the other four show, in increasing ratio, the backward

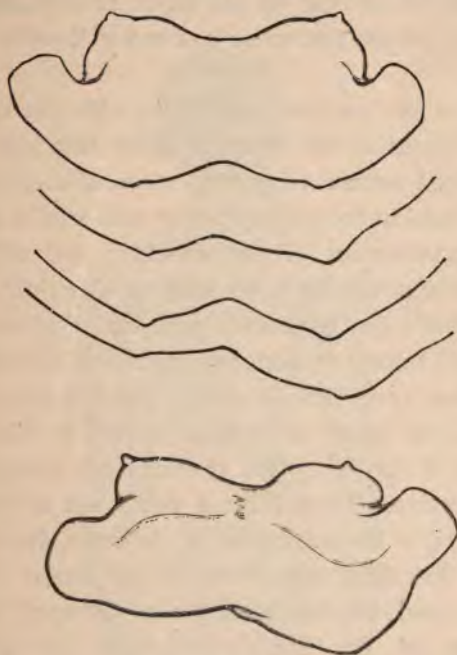


FIG. 22.—Diagram of Rotation. The chest, back, and shoulders are seen from above, the head is omitted, as being in the way of this view. In the middle line of the back is the groove where the spinous processes might be felt, outside this is the posterior aspect of the thorax, a little further out the projection is the base of the scapula. The line beyond is the dorsum of that bone.

projection of the ribs on the right of the spine (convex side) and the flattening on the left (con-

L

cave side). Also the gradual movement of the bases of the scapulæ outward and their change of position, viz. so that on the right its dorsum looks outward, on the left more and more directly backward.

But as yet we have not to do with any case so far advanced as the lower of these diagrams, even the second outline represents more change than is to be found in the earliest phases of dorsal scoliosis. The examination of the shoulder and adjacent parts, which has been so long in description, occupies but a few minutes in practice. The surgeon then, still taking no notice of the line of the spinous processes, turns his attention (as I have recommended in cases of lumbar curve) to the side outline of the body, the patient still standing in drill posture. First, I must point out a peculiar alteration in the setting on of the arms, due to the above described alteration in the shape of the thorax and to the consequent changes in the position of the scapula whereby the glenoid cavity, therefore the shoulder joint, is thrown forward on the one side, backward on the other. Therefore, as the figure is looked at from behind, the right arm (that on the convex side) appears to spring directly from the trunk; it is, as it were, sessile; while that on the left (concave side) is further away; it is, as it were, pedunculated; in

other words, the axilla on the right seems narrowed laterally; that on the left, widened in the same direction.*

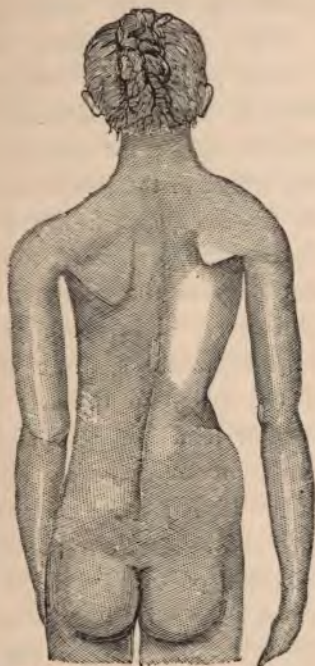


FIG. 23.—Dorsal Curve, later stage.

Let us now trace from the axillæ the side outlines downward in a case rather more advanced than

* Certain other peculiarities in the position of the arms will be mentioned immediately.

that shown at Fig. 21, in one such as is depicted at Fig. 23. On the right (convex) side the line from the arm-pit to the ilium, which we will call the thoracic segment, is rather more rounded and convex than in the normal figure. At the waist is a pretty strong incavation ; but it is not, as in lumbar curve, an angle ; and below this the hip projects pretty strongly ; for in this stage a consecutive lumbar curve to the left is formed.

On the left (concave) side from the onsetting of the pedunculated arm downward, the side outline is concave, not only in the thoracic part, but for some distance below. Unless the young woman have worn very tight stays, there is no distinct incavation of the waist on the left side, such as divides the normal feminine figure into a thoracic and pelvic segment and throws into relief the prominence of the hip. On the contrary, the whole left side outline continues from the arm-pit, down to below the crest of the ilium, in one simple concave curve, which only terminates about the level of the great trochanter, when the convex outline of the thigh begins.

These modifications in the side-outline connote that a certain change has taken place in the relative position of the upper and lower segments of the body ; if one merely considers the figure as far down as the level of the trochanters, the former

looks as though it had moved on the latter towards the right—it does not look oblique, leaning over—but shifted *en masse*, as though still maintaining its general parallelism, with the perpendicular it had glided to the right; indeed, some writers have described the position as though such displacement of thorax on pelvis, had actually occurred. I will not say positively that this is really a very rare event, but I may say that in the vast majority of instances, the appearance is produced by a pelvic displacement to the left, the lower limbs sloping from below in that direction (see p. 113).

This explains what, previous to my detection of the fact, seemed to me very inexplicable, viz., the relationship of both arms to the trunk. It is necessary to refer the reader back to Figs. 21 and 23. In both it will be seen that at their junction at the shoulder, the two arms are differently placed in relation to the thorax, not anatomically, of course, but as regards the view from behind (see p. 146). Yet when those limbs are traced down to the wrists it will be noticed that the right one—that which is sessile to the trunk above—lies at a distance from the pelvis below; that which is what I venture to call pedunculated on the chest, lies very close to or even overlaps the pelvis. In the former of the two figures referred to, the arms are parallel and perpendicular—in the latter,

anxious to illustrate my point, I fear that I have slightly exaggerated the distance of the right arm from the pelvis. However that may be, this disposition of the two arms in relation to the pelvis is produced in almost every instance by the displacement of the latter part of the figure to the left, encroaching, as it were, on the arm of that side. Whenever this disposition of upper limb is noticed, means of ascertaining whether or no the pelvis be amesial should be always adopted.

We now return to the surface of the *torso* and note that the upper segment lies on the right (convex) side considerably behind the plane of the left—the lower or lumbar part, if there be consecutive curve, is in the reverse relationship, *i.e.* the left side posterior to the right, as was explained when speaking of lumbar curve. The dorsal segment is chiefly important just now, its surface varies considerably in shape in different subjects, the variation depending partly on the relative degrees of rotation and of lateral deviation, partly on the actual locality of the curve, that is to say, on the actual numerical vertebræ involved (for they are not always the same), partly on the degree of distortion. In the milder cases a mere slight bulging or enlargement of parts around the right scapula is noticeable, in more severe curvatures this backward projection is continued down to the eighth

or ninth rib, as in Fig. 23, it appears as a rounded eminence ; in still worse cases the roundness is lost,



FIG. 24.—Severe Dorsal Curvature with consecutive cervical curve and enlarged root of neck.

and the projection keeping the same place becomes

a sharp ridge, thrusting itself back between the scapula and the spine, it forms the so-called "hump" of lateral curvature, as seen in the right shoulder of the annexed plate, and in the lowest of the diagrams in Fig. 22. On the other side the deep hollow left by forward projection of ribs and scapula is well marked. The "hump" corresponds with the angles of the ribs, which, as already stated, have become greatly diminished, *i.e.* much sharper, but the diminution of this angle is not the cause of the projection; which could not result if the angle simply got sharper, while the first part of the rib retained its position: the projection is really due to the abnormal backward course of this first part, and this course is permitted partly by vertebral rotation, and partly by that deflexion towards the middle line of the transverse process which has already been the subject of comment? The sum of this backward projection and of rotation is measurable by the scoliosis gauge. If it be thought desirable also to measure the angles of the ribs, the old device of moulding to the surface a strip of lead, and tracing its form on paper, can be employed. It is advisable to do this, if at all, while the patient stoops forward and rests the palms on her straight knees, of course care must be taken that the wire passes horizontally over the back; though the method measures the angle of

the rib, it is not to be relied on as a measure of rotation.

And now, last of all, the surgeon should examine and measure the line of the spinous processes. To estimate by eye merely, and to retain in memory the exact amount of deviation is all but impossible to one engaged in pretty extensive practice, therefore some means for accurate measurement is all but essential. By marking the centre of the processes with the aniline pencil, and dotting the skin in the true perpendicular with the upper marking wire of the scoliosis gauge, one may measure the deviation of every vertebra, if it be thought desirable; but it is generally sufficient to take the two most aberrant bones of the dorsal and of the lumbar region.

When the curve is prolonged high up in the dorsal spine, as is usual in severe cases, the first vertebra of that region is a little to the left of the middle line, and its transverse axis becomes oblique, hence its right rib lies a good deal higher than its left one; this is shown, indeed is probably a little exaggerated, in Fig. 9. The clinical result is such as is seen in Fig. 24, viz. an enlargement of the side of the neck, chiefly behind, (under the trapezius)—the outline from the head to the acromion is abnormally convex, this enlargement may be felt to be hard, and all the lower half of the acromio-mastoid line,

all the part above the scapula, to be thick and resisting.

Primary dorsal curve to the right and primary lumbar to the left, the most common forms of curvature, cannot be distinguished from each other, if the line of the spinous process and the backward projection of the right shoulder alone are considered. But by studying the modifications which the side outlines undergo, by noting the apparent shifting of the upper on the upper half of the figure, a diagnosis can always be made, except in old and severe cases, when it is neither possible nor of value. One aid is a peculiar change of form, which I have not hitherto mentioned, because I cannot account for it ; it is, however, always or nearly always, present in dorsal curves, a little beyond the initial phase, namely, an appearance of thickening and enlargement just outside the sacro-iliac joint of the right side ; it is a full, rounded, slightly backward projection, involving very little change of form in the part.

The reverse form of curve, viz. dorsal to the left, with consecutive lumbar to the right, is by no means uncommon, especially in hospital or dispensary practice ; its locality in the column is sometimes the same as the ordinary right dorsal curve, but it is more subject to varieties, often affecting a lower part of the back, as from the fifth or sixth

dorsal to the second lumbar; here the primary curve may be very strongly marked, while the spine above and below may exhibit only slight



FIG. 25.—A Low Left Dorsal Curve, Congenital (?).

aberration. In the skeleton, the curve appears to project sideways, like a short but rather deep loop-

line from the main railway route. In such cases the spine above the first aberrant vertebra is but slightly deviated and is often lordotic. The parts at the left side of the lower part of the back and upper part of the loin are strongly prominent, nearly down to the ilium, forming a long rounded projection, most marked at or about the level of the ninth dorsal vertebra and ceasing rather abruptly above and below. The trunk of such subjects is short, so that the legs look disproportionately long. Most, if not all of these are rachitic cases, and have probably carried burdens in very early life.

The lad from whom Fig. 25 was drawn says his mother always told him that he was born with a crooked spine.

CHAPTER IX.

ON CERTAIN PREVALENT MODES OF TREATMENT.

BEFORE entering on the subject of a treatment, which I introduced more than twenty years ago, which has had many followers, and in my hands large success, it is necessary to cast a rapid glance at methods which, in 1868, were the only ones practised, and at some others which are also used at the present day. At the date indicated there were two methods of dealing with curvature, the one by certain mechanism, the other by gymnastics.

The implement, Fig. 26, of which there are innumerable modifications, one only can be depicted here, is called a spinal support, because it is supposed to support the crooked spine. It consists essentially of a metal belt, surrounding the pelvis, which bears at each side uprights terminating in crutch handles for the shoulders to rest in ; at the middle line at the back is a lever—sometimes two—movable by rack and pinion, and supporting a metal pad ; if there be two, the left one is opposite the lumbar, the right one opposite the dorsal prominence.

The object aimed at is this: the patient being placed in the machine, the steel belt is fastened round the pelvis; the crutch handles are placed under the axillæ, the uprights which carry them are then lengthened by screw or ratchet; the levers and pads are brought towards the middle line, by the rack and pinion, with the intention of forcing the curves straight. The additional bands, one laced



FIG. 26.
An Orthopædic "Support."

round the abdomen, one round the chest, are intended to keep the mechanism in place, and in many instruments straps pass over the acromion, from front of one horn to the back of the other crutch, to confine the shoulders within them, a device of which more will be said imme-

diately. Thus the girl who is subjected to wear such an appliance must do one of two things: she must either slip her shoulders out of it and, moving her trunk forward or backward, free it from the pressure of the pads, or she must be content to have her body, *i.e.* her loins, chest and pelvis, move all in one piece, like a wooden doll. If she elect the latter, and if she have patience and endurance enough to

undergo such imprisonment, she will gain little or nothing. Probably my testimony as to their inefficacy may be vitiated by the fact of my never having used but one. Therefore it will be better to quote the opinions of some who do or have employed them: "They are not adapted to the removal of the primary cause of curvature; they cannot therefore be employed as curative means." * "I have no hesitation in expressing my conviction that if these cases be submitted to treatment before any very obvious external deformity has occurred, they are generally curable within one or two years. In some instances, especially if an hereditary tendency to spinal curvature exist and the girl be of feeble constitutional power, a longer period may be required." † "When rotation has taken place, appliances are useless." "The result of my experience is to convince me that where lateral curvature existed in any marked degree, and before it amounted to an external deformity, it is essentially an incurable affection." ‡

These avowals would be very sad if they referred to any other treatment than that by "spinal

* Little, 'On Deformities of the Human Spine,' p. 379.

† 'Adams' Lectures on Curvature of the Spine,' p. 327, 1st edition.

‡ Brodhurst and Adams at Medico-Chirurgical Society, *Lancet*, January 23, 1886.

supports." The second quotation, which appears to mean that, if a strong young girl of healthy parentage be fastened into such a machine, she perhaps may be cured in about two years of a deformity which can hardly be said to exist, is a phrase which very truthfully characterizes the uselessness of the appliance. It refers, be it observed, to the special mechanism above, copied from the work in question, intercalated in a paragraph recommending it to be worn during the day, sometimes also during the night, and the quotation following closely thereon sums up the result as above given.*

The inefficacy of all this class of instrument arises chiefly from the impossibility of securing immovably a metal hoop to such rounded parts as the haunch and buttocks ; even if it were possible to fix it to the soft parts, yet these, especially in children and young women, are very movable upon the bones. As, however, the hoop is the foundation from which the levers play, they can have no power unless their bearing be steady, because screwing the lever instead of producing pressure on the back simply raises or depresses one or other side of the pelvic hoop. Very many patients have been

* Let it not for a moment be supposed that my words are dictated by any feeling adverse or inimical to any one of the gentlemen whose expressions I have quoted. I am writing not about individuals but about mechanisms.

brought to me wearing these things, still quite new and recently adjusted, and I have invariably found that, by taking hold of the lateral uprights or of the levers, one might shift the metal hoop up or down, or, on grasping the hoop, the whole superstructure could be displaced from side to side. Therefore, the patient, on moving her back, always shifts the band upon the pelvis. A great many modifications of this mechanism have been contrived. As they are all founded on the illusive idea of fixing a more or less immovable belt on the pelvis, they all are rendered nugatory by the same fundamental and capital defect. Indeed, some surgeons and instrument-makers, having perceived this, have added to the already too heavy and costly appliance a rod hinged by its upper end to the pelvic hoop and by its other secured to a band strapped round the thigh. It is, of course, evident that such a contrivance can only increase the difficulty, by adding the motions of the lower limb to the already too precarious fixation of the pelvic belt—the would-be fixed point of the construction.

But even this structural fault is less egregious than that of strapping the patient's shoulders into the crutch handles. Be it recollected that the girl's back being crooked is shortened, that this shortened back is fastened into a machine with a belt round the pelvis, and that the shoulders are strapped

into two uprights which must, if they act at all, keep the spine at the same degree of shortness ; then the orthopedists think to straighten it with screws and ratchets. A bow, which straight should be five feet long, may be bent by its string to a four-foot length ; as long as the string and the wood-work hold, no power will straighten that bow. So to fasten down a crooked spine to its morbid length and then try to straighten it is, to say the least, a very singular idea. Fortunately and mercifully all the bearings, straps and hoops cannot act as they are intended to do ; for if they did thus bind the figure down, and then squeeze the ribs to right and left, they would be even more potent for evil than they are ; however, almost too much space has been expended on this subject.

In 1880 Mr. Adams suggested the use of poroplastic felt, cut into the form of a corset, and I believe priority in this idea belongs to him.* The felt, when thus cut and impregnated with shellac, is to be moulded on the figure during suspension ; the idea is ingenious and the appliance does not get out of shape in very slight cases occurring in small young people ; but, in any beyond a mere initial stage, the power and weight of the trunk far

* 'British Medical Journal,' 1880.

outbalances the resistance of the material. Therefore, when a patient, who has worn such a jacket for a few days, presents herself again, one always finds, not that the jacket has modified the back, but that the felt appliance has assumed all the morbid bends and projections of the trunk. Any attempt to obviate this yielding, by strengthening the jacket with steel bands and hoops, encounters the above specified impossibility of securing a sufficiently immovable basis on the pelvis. Nevertheless, very slight curvature occurring in a patient who is not too young, that is of an age to be thus immobilized without loss of health, may be benefited by this appliance. It ought not to be used for growing patients with that necessity for free bodily exercise which youth implies; for elderly people, with the second recrudescence of curvature (p. 62), it is generally unbearable.

A somewhat similar, but far better mechanical design, is Dr. Lewis Sayre's plaster of Paris jacket and self-suspension. This latter device is effected by the usual tripod and system of pulleys arrangement, but only the headstall, without the axillary loops is used. The patient, grasping the pulley-rope, draws herself up, hand over hand, some little height, then pauses, taking care to do so with the hand on the concave side highest.

In this position the plaster of Paris rollers are

put on and allowed partially to set, when the patient is taken down, laid supine, and the jacket, being cut open from the front, is removed and handed to an instrument-maker, who turns over its edges the redundancy of the vest, fits it with lacing-hooks, &c. The jacket must be made of particularly good strong plaister, as it must be rather thin, and is to be put on during self-suspension every morning, and removed under the same conditions at night. The jacket must be occasionally renewed, entirely or in part, if the back improve. Dr. Lewis Sayre claims to have great success with this mode of treatment; it does not seem to have equal advantages in other hands. I formerly used it for a few patients; the first application certainly produces, especially in severe cases, considerable improvement, the back remaining while erect only a little more crooked than it is in suspension. But here the progress makes a halt, and, as far as my experience goes, does not get beyond that point. In hot weather the patients complain bitterly of the heat and discomfort of the bandage.

Dr. Lorenz uses also in a slightly modified form suspension and plaister of Paris. The suspender (Beely's) is formed of two perpendicular struts bearing a cross-beam, like old-fashion gallows. Above the arm which holds the headstall is a horizontal bar, so arranged that, when the former

is in place, the patient can grasp the latter at the full stretch of her arm. The pelvis is kept fixed by a rod passing from one limb of the gallows and terminating in a belt, partly metallic, which surrounds that part of the body. The bandage does not reach as high as those of Sayre, and he fastens down its left side to a leathern thigh-belt (he calls this "*Seitenzugverband*"). Another, which he calls "*pressure bandage*," only differs from Sayre's, in that he places pads of felt on the right anterior, and on the left posterior part of the chest, before applying the plaister. The bandage, being removed and dried, is padded internally on the contrary localities, viz. over the right posterior and left anterior aspects of the chest, the object being to leave the plaister over the first-named localities hollow, and by the subsequent padding to press the chest into those empty spaces. I will not deny that this ingenious device may in some cases succeed; but to wear such a bandage, which with these reversed paddings, of course, does not fit, evidently requires some fortitude, as indeed do other parts of Dr. Lorenz's treatment. The girdle band (*Gürtelverband*) for lumbar curvature is shorter above than the *Seitenzugverband*; it is put on while the patient bends her trunk powerfully to the left (to the convex side), and is also fastened down to the thigh by a thigh-belt

and strap.* With these bandages Dr. Lorenz combines, what he terms lateral suspension and methodical *redressement* of the spine. A sort of scaffold supports a wooden beam, cushioned and guarded. The patient stands on a small step, passes her right arm over the cushion and disposes the posterior projection of the right ribs upon it; then grasps in her left hand a handled strap, fixed near the floor on the far side of the cushion, so that her left arm is drawn over her head, the hand being rather below the level of the cushioned beam; she then takes her feet off the step, so as to hang on the beam, pressing the rib-projection against it. To this lateral suspension he adds severe pressure with his hands on the left front of the chest (und übt in der Richtung des rechten schiefen Diagonal-Durchmessers einen kräftigen Druck aus). It is a most painful procedure. He says: "Certainly many weeks must pass before the *redressement*, thus energetically carried out, is borne by the patient without suffering."—"The extreme painfulness of the first attempts at *redressement* during which the spine formally cracks at its junctions."† "It cannot be accomplished without tears."‡

* This seems to me to have no more action and to be much less bearable than my lumbar bandage, p. 177.

† Very possibly the ribs, rather than the spine, crack at their joints.

‡ Loc. cit., pp. 176-7.

Gymnastic exercises are very conducive to health, and strengthen the muscles of the trunk and limbs ; they therefore are often useful in cases of weak backs, as preventive of the tendency to curvature, which that debility induces. Also, some properly devised movements are valuable aids to real treatment of curvature. But it is vain to expect benefit to a spine already curved, from holding one arm perpendicularly upward and the other horizontally outward ;*—or, from : “Lying on back, simultaneous extension of arms upwards, outwards, and downwards, from a position with elbows flexed and close to the trunk (four times);”—or : “Lying on back, arms by the sides of the body, hands supinated, slow full inspiration by the nose, slow expiration by the mouth (repeated four times).” † Surely, however,

* A patient was exhibited on 13th of November, 1885, with severe curvature. She was ordered by Mr. Roth to maintain this posture (he calls it key-note position) for a certain time daily. On March 12th she was shown again, that gentleman affirming that her general carriage was much more upright. But Mr. Keetley, who on both occasions measured the patient, conclusively proved that the curvature was in no way altered. Such improvement of general health and strength as had undoubtedly taken place was the natural result of her having ceased to wear “a spinal support.”

† These are two out of the twelve movements prescribed in Art. “Lateral Spinal Curvature,” in ‘Dictionary of Practical Medicine.’ It is only fair to say that three of the exercises ordered have a little more influence in strengthening the back-muscle but none on the curve.

it is hardly desirable to waste space and time on such trivialities. All that the Ling-Swedish method can do (save prophylaxis) is to preserve and in some cases, especially after wearing spinal supports, to restore a certain flexibility to the column.

In the Zander Institute are certain mechanical exercises intended to move the spinal column. These are numbered and headed in the descriptive catalogue: "C. 7—Rotation of the Spine (active). D. 6—Rotation of the Spine, Lower Portion, and C. 3—Rotation of the Spine (active)". It will be remembered that in the common S-shaped curve the dorsal vertebræ are rotated in one direction, the lumbar in the other, the transition taking place at the ninth or tenth dorsal. Herein lies the very great difficulty in undoing the one twist without increasing the other—that is, of limiting the rotating power of these mechanisms at the point where it should stop. The Zander contrivances fail, in my opinion, to fulfil this essential indication.

Hygienic calisthenics are very valuable in strengthening the muscles and keeping them active, and thereby of course diminishing the tendency to lateral curvature; but not in curing the curvature once begun.

CHAPTER X.

THE TREATMENT OF LUMBAR CURVATURE.

THE treatment of lateral curvature varies considerably, according to the region of the spine it affects—to its severity, and to its cause, and to the patient's age.

The simplest form, both in causation and treatment, is the lumbar, or the simple total curvature arising from obliquity of the pelvis.

Patients in the first septennial period are brought under treatment with very different degrees of uneven limb-growth, and very various degrees of curve, the exact period of consultation depends on the vigilance of the nurse or mother. I have had patients when the bend of the spine was, when first put in drill posture, scarcely perceptible; after a few minutes or seconds a little fatigue supervenes and the signs of curve gradually become evident. Other infants manifest symptoms of crookedness at once. In whichever way the appearance shows itself, the cause must be sought. Firstly, the signs of rickets must be carefully looked for; let us

suppose them entirely absent. The feet should be examined for valgus, &c. Even the boots should be looked at. The instrument described in Chapter VI. will immediately point out whether or no there is any pelvic obliquity. Let it be supposed that the right crista ilii be found about 0.4 of an inch higher than the left, and that there be left rotation at the third lumbar vertebra of 3° . The next object of investigation is the flexibility or want of flexibility in the spine. This is attained by taking hold of the pelvis just above the trochanters and moving it, the knees being kept straight, from side to side; at first the gyrations should be small in amount and slow. Then, as the child gets accustomed and loses all distrust, they are to be increased both in width and rapidity. The spine, meanwhile, is to be watched and its bend to left and right noticed. Then she is to sit on a chair or stool and, while her attention is attracted by a toy or cake, the posture or condition of spine must be watched. Lastly, the seat is to be made to slope from left to right, and the action of the back under such circumstances also observed.

By these manœuvres the surgeon will have acquired the necessary basis for determining his treatment. If the spine be quite flexible and nearly equally so in both directions, it is in these
or cases quite manageable without any

retentive appliance, a mere change in the conditions of balance and a certain manual extension will have the desired effect, but not immediately. I am again and again asked by mothers, how long will it take to cure the spine. The only possible answer is to explain how and why pelvic obliquity causes the curve, which is not a malady of the spine itself, that the obliquity depends on uneven growth of the limbs ; that all which can be done is to watch—to obviate its effect on the back ; that, if this be done, the spine will be, when the legs become of equal length, perfectly straight.

If the curve be pretty sharp, it is wise before letting the child dress again, beyond the under-clothing, to counteract the effect of faulty position, which may have continued unnoticed for many months, and which may have caused some shortening of ligaments and perhaps of muscle. To do this, the surgeon sits on a chair, and, placing the child with his back towards him, he grasps between his knees the child's pelvis ; then taking hold of each side of her chest, about the level of the eighth vertebra, he bends her down to his left as far as she can go, merely by her own weight and effort, then he adds a little pressure with his right hand, keeps her there about a minute, and repeats the manœuvre five or six times. The following measures are now to be ordered : the left shoe is

to be heightened in such slight cases ; the in- and out-door shoes may have an additional thickness of leather put to the heel ; or if the inequality be greater, or later in the case, it will be well to let one thickness be also removed from the right. It is not advisable, unless the obliquity be very small, to annul it at once, lest, as I have experienced, we produce some uneasiness that will cause the child to adopt a new malposture : an inequality of 0·4 or 0·6 of an inch should be two-thirds corrected.

In sitting, the child's spine should, for a certain period every day, be made to bend pretty decidedly in a direction reverse to that of the curve. For this purpose I devised, some twenty years ago, the "sloping seat," it is merely a hollow wedge of wood placed on a chair with a sufficiently firm seat. To make out the amount of slope, there is in my consulting room a stool with a ratchet and wheel movement, whereby I can raise the seat to any desirable angle, and of course to either side. By seating the child on this, and turning the handle slowly, it is easy to ascertain the desirable amount of elevation. A carpenter can make in an hour a wedge, the description of which in writing my patient takes away, it runs thus: Of half-inch deal, two boards 14 inches by 11, screwed together at one end, separated at the other by a cross-piece

x inches high. It is well to cover it with plush or cotton velvet, so that in drawing the hand from the high to the low side it meets the rough of the pile.* This sloping cushion, which is between an inch and two inches high, is not to be used all day, as some writers in quoting me have supposed me to say, such use would fatigue the muscles and do perhaps more harm than good; it is intended to obviate ligamentous and muscular shortening, by bending the spine pretty sharply in the reverse direction

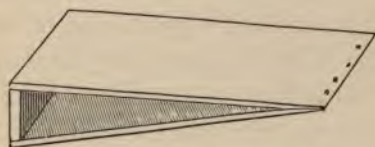


FIG. 27.—The Sloping Seat.

from half to three-quarters of an hour, three or four times a day is enough.

For a slight and simple case, in a quite young child, this treatment will suffice, but it should be

* Volkmann borrowed this idea, appropriating it by a modification, whereby the upper plane works on a ratchet, so that the slope can be altered. This is by no means an improvement, for the use of the appliance must be much in the hands of the child's nurse, and it is better to avoid giving her any hap-hazard choice in the arrangement of the height.

watched, some difference in the rate of limb-growth, some spurt of growing in the spine may, from month to month, necessitate either its discontinuance or more stringent measures. In these patients it is better, if possible, and it generally is quite possible, to cure the curve without recourse to retentive appliances.

Older patients, sometimes even very young ones with a more marked lumbar curve, require more vigorous treatment. The same devices of high shoe and of sloping seat may be used, and this will probably be the best opportunity of explaining the principle of their action. A glance at Figs. 10 and 11 will show how a shorter limb, by causing the pelvis to slope, produces a curve at the loins, and how this curve is annulled by placing a block under the shorter limb. Raising the heel of that side, or, if the shortening be considerable, heightening the whole sole, aims at producing this effect in a more permanent manner. The amount of additional sole should not at first be enough to quite annul the pelvic obliquity unless that is very slight. But there are a number of cases of what I have called habitual pelvic obliquity, see Fig. 14; if such a patient be placed in drill posture the pelvis becomes horizontal; yet, unless very early in the case, the curve continues. This condition is so frequently overlooked that many writers within the last

decade have affirmed that the pelvic obliquity is less frequently a cause of lumbar curve than is supposed. The error lies in forgetting that there are two causes of that condition, and that habitual obliquity disappears when the patient is placed in drill posture ; but it reappears when she is left to herself and its effect, the curvature, remains.

The high shoe placed on the convex side (the left in typical curves) will assist also in such cases, but not alone—it is necessary to watch the patient closely while standing, and, if such habit be detected, to strictly enjoin its discontinuance, and to counsel the opposite posture, *i.e.* standing on the other leg and letting the right side of the pelvis droop ; the high shoe on the left foot, the one she is to stand on, will recall this injunction to her mind and help her to carry it out.

The sloping seat is devised on the principle of carrying a correction, or rather an over-correction of the obliquity into the sitting posture. The accompanying engraving, published more than twenty years ago, is taken from one of my patients whom I had all but cured of a rather severe lumbar curve, with consecutive dorsal, represented by the dotted line. The figure is placed upon such a seat (p. 176) as lifts the left side of the pelvis to a rather higher level than the right, when the spine, by the necessity of balance, tends to assume a curve in the

opposite direction. Tends, I say, because all spines notably those which, being in the second stage, are somewhat stiffened in the abnormal posture, cannot



FIG. 28.—The Sloping Seat in action. The dotted line represents the direction of the morbid curve, the shaded line that which the artificial obliquity tends to produce.

at once turn in the opposite direction ; for these, certain further treatment, to be described immediately, must be employed.

In such cases also an appliance, which I have named the lumbar bandage, is to be adopted. It is a very simple contrivance, giving the patient, even young and irritable children, no trouble. Of

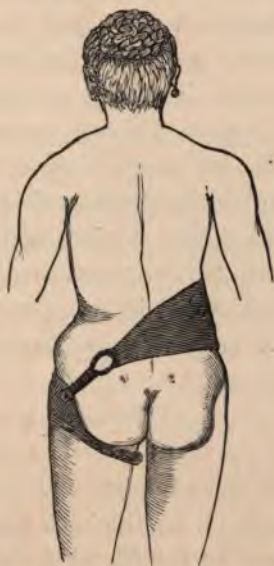


FIG. 29.—The Loin Bandage. In this figure the curve is to the right.

course, each one is to be made to a pattern cut in brown paper to the figure itself, but it is worn outside the under-clothing, most conveniently over that form called a "combination garment." The bandage consists of a webbing strap, passing

round the upper part of the thigh, and made round where it lies next the perinæum by being drawn through an india-rubber tube which, again, is covered with kid- or wash-leather; *this strap secures on the outer part of the ilium behind and upon the trochanter a semilunar portion.* This leg-piece is merely a fixed point from which the rest does its work. This rest consists of a well-fitting oblique portion, which is secured by a clasp to the back of the leg-piece; to the clasp is attached a webbing strap, which terminates in a strong india-rubber ring, and thence a piece of moleskin, jean or coutil, cut to pattern, sweeps round the loin, breadthens considerably in front, terminating like the part behind on a ring and strap fixed to the front of the leg-piece.†

Between the ring and the clasp, a buckle, with an arrangement to prevent the patient tampering with it, enables the surgeon to place and keep the tension aright. In putting it on, the back ring, that seen in the figure, should be considerably tighter than that in front, by which means there will be no tendency of the hip-pad to ride forward.

* Some patients are better fitted by a trapeze, small end downwards.

† The shape of the front is shown in some diagrams (Figs. 38 and 39).

In all but the first stage of curvature, some of the muscles, intervertebral discs and yellow ligaments, have undergone a certain amount of change, and although the sloping seat and some other of the above devices have the effect of removing those alterations, yet their work is slow. For some years past, I have been perfecting and using a more potent method. If dealing with a curvature at the loins only, with no dorsal secondary deviation, the arrangement is very simple. An ordinary horse-girth is attached by each end, either by a strap or cord, so as to form a loop, the cord part of which is fixed by a hook to the wall. The girdle embraces the patient's loins on the convex side; when this is taut, the patient bends the body sideways, well down to the left, keeping the knees straight, and the surgeon placing his hand on the right side of the chest, on a level with the nipple, presses the body over with some little force. The girth, three inches broad, should be half on the ilium, half on the loins, so as to fix that lower region of the spine as well as the pelvis, a pad or folded towel being introduced between the girth and the underclothing, and the patient may either stand or sit. The latter posture is preferable, if the patient be feeble and find it hard to keep the knees straight, or if much force have to be used. It must be recollected that the object is to stretch contracted and shortened

parts, and the power employed must be commensurate with the amount of deformity, and with what the patient may bear without pain. In this latter point of view, the first efforts are experimental and should not be carried too far. I have never had any injurious or painful results, and if the loin bandage be applied immediately afterwards, and no excess in walking or standing about be permitted, the very slight aching, which in a few cases follows, disappears in a very short time. I venture to call this treatment, and more especially its modification for the S-shaped curvature, "*rachilysis*" (loosening of the spine). Its derivation is sufficiently obvious. In order to maintain the advantage thus gained, the patient is directed to carry out the following manœuvre: A girth, similar to that just described is kept in her bedroom or nursery, and it is secured to a hook in a like manner, only, if possible, the hook should be at a corner of the room, about four inches from a wall running at right angles to that on which it is fixed. She stands with her back against this wall, and within the girth, as above described; places her right palm, thumb backward, on her side as high as she can, keeping the elbow squared. She then throws the shoulders and trunk forcibly over to the left as far as she can, and, resting so a few seconds, rises up again slowly to the erect posture. All this is to be done with the

back against the wall, to prevent any forward or backward stoop. The number of repetitions must depend on the patient's strength; it is better to begin with too few, rather than with



FIG. 30.—Rachilytic Exercise for Lumbar Curve.

too many, and gradually to increase them. The lumbar bandage should be applied as soon as the exercise, whether or no assisted by the surgeon, is accomplished.

Rotation of the lumbar vertebræ cannot be

antagonised by any direct mechanism, but I have always found that, as the lateral deviation disappeared, the rotation was also annulled. In that particular, as also, I believe, in its causation, it differs from the rotation of a dorsal curve.

CASE IV.—Miss L., aged 24, has for some time been suffering from a curvature of the spine, and has worn for more than four years the usual form of orthopædic support. She came to me on the 5th May, 1866, and gave the following history.

About five years ago, she, being previously well and hearty, began to lose health, and suffered pain in the back; these symptoms increased, menstruation became irregular, and all but ceased; appetite failed, breathing became short and difficult. She was taken to a practitioner near her residence, and he, in examining her, found signs of curvature, and sent her to London in 1861. The orthopædist, whom she consulted, told her that she must remain some considerable time in town, and wear an iron support. She did remain the greater part of a year in London; during which time the instrument was screwed up, at first thrice, then twice a week, and afterwards once a week. At the end of rather more than ten months she found herself unable to stay longer, or to afford further treatment. The instrument was very much tightened, so as to last longer without alteration, and she left London. At that time she was suffering more pain in the back; her health was much broken, and she was, when the instrument was removed, more crooked, although she says that when the scaffolding was tightly screwed she was a little taller. She had, however, lost health more rapidly; had become very thin; was very easily wearied; scarcely able to walk; her appetite was very small, and somewhat capricious; she suffered also considerable pain, chiefly on the right side. She continued to wear the instrument for some time, in the country; but after a little more

than two months her strength so failed that she was obliged to take almost entirely to bed and the sofa, leaving off the scaffolding. Her health now began to improve again, and as she shortly was enabled to get about, she became again desirous of improving the shape of the spine, and resumed the support, but found again that her health failed, and was obliged to discontinue it. After six weeks more she consulted me.

At the date above given, I found her pale and weak : she could not sit up for more than a few minutes at a time ; appetite bad and capricious ; pulse small ; menstruation irregular and scanty.

The following measurements give the curvature of the spine. A silk thread between the 7th cervical vertebra and the middle of the sacrum crossed exactly over the 9th dorsal spinous process. The 2nd lumbar spine was $1\frac{1}{8}$ inch to the right, the 5th dorsal was $\frac{6}{8}$ inch to the left. When she lay down the curve decreased.

In this case it was, I felt, necessary to be very cautious in the application of any treatment. I ordered therefore at first a seat, sloping only $1\frac{1}{2}$ inch in 15, for ten minutes twice in the day, to rest on the back immediately afterwards, and to take steel wine twice a day—a steel and aloes pill night and morning.

May 18th.—She is better in health ; the back has, of course, hardly altered, but the hardness and protuberance of parts on the right of the spine are rather less marked. A bandage has been constructed, and this was now applied with but little tension ; to continue the sloping seat.

June 12th.—The health has decidedly improved, and the patient has gained flesh with rather remarkable rapidity : the back also is better, the improvement being chiefly manifest by the decreasing rotation, as seen in the greater equality of hardness on each side of the spine.

July 20th.—In the three or four visits since the former date there has only been to observe the gradual improvement in health and in the form of the back : a higher slope to the seat

was instituted a fortnight ago ; the tension of the bandage has been two or three times rearranged. The deviation was to-day carefully measured : 2nd lumbar spine $\frac{5}{8}$ inch to right, 5th dorsal $\frac{1}{4}$ to left. We have then gained $\frac{3}{8}$ on the lumbar (primary) curve, $\frac{1}{2}$ inch on the dorsal secondary curve. This, I may remark, is not uncommonly the case ; the secondary curve yields first and most.

August 28th.—Again I leave an interval, in which there is nothing especial to remark ; improvement during that time has been, however, more rapid. Health is now very good. Menstruation has occurred with perfect regularity in the last three periods. She has sufficient colour and plumpness ; appetite good. Measurement gives the following result : The 2nd lumbar spine lies so that the straight line is $\frac{1}{4}$ inch from its left border, and touches the right edge of the 5th dorsal vertebra.

Oct. 2nd.—The patient may now be considered well. The line of silk touches all the vertebræ ; no transverse processes can be felt, but the parts on each side are equal in hardness and resiliency.

A note or two of cases with habitual and with permanent obliquity may be desirable.

CASE V.—Miss F. H., aged 16, came to me July 19, 1869, with lateral curvature. The girl is tall and largely built, sufficiently fat, but not strong ; has lately had chorea, of which traces are still left.

The spine was considerably curved both in lumbar and dorsal regions ; the spinous process of 2nd lumbar vertebra lying $\frac{7}{8}$ of an inch to the left of the perpendicular thread. While placed in drill posture, no inequality in the height of the ilia could be detected ; but it was difficult to make her stand straight : she always wrung the lower part of the body so that the left side of the pelvis lay anterior to the right. Suspecting some habitual malposture of the lower limbs, I

watched her closely, and on several occasions detected her standing only on the right foot, while the knee of the left was advanced in front of the other and bent. She was strongly warned against this habit. The use of the sloping seat and a piece of cork on the left boot were prescribed. After a month a loin bandage was ordered, and tonics were given.

It is unnecessary to give long records : suffice it to say that the docility of the patient has enabled her to make rapid progress. On the 4th of April, 1870, a perpendicular line touched the right side of the 2nd lumbar spinous process, and the case was nearly well.

In December 1873, I saw this patient on account of a severely sprained ankle, and when she had recovered I took the opportunity of examining her back. It was perfectly straight, nor could I by the most careful tests find any deviation from normal form. Her figure was slim and remarkably elegant.

CASE VI.—Mr. —, aged 16, came to me October 1869, with lateral curve, which had prevented his entrance into the army. He was tall and slight, but of sound health. I found a long lumbar curve, which disappeared entirely on recumbency, and partially when he sat down. A further examination showed that, when in the drill posture, the right crista ilii was $\frac{7}{8}$ of an inch higher than the left. This measurement was taken on an upright staff, to which a rectangular movable arm was attached. He was then placed recumbent, and the lower limbs measured from the top of trochanter to the junction between femur and tibia on the outer side (easily felt in so thin a lad), and from this point down to lowest point of outer malleolus ; they ran thus :—

				RIGHT		LEFT
Thigh	..	..	..	$17\frac{3}{4}$		$17\frac{1}{4}$
Leg	..	..	..	$17\frac{1}{4}$	A little less than	17

In this case the sloping seat and a bandage were ordered.

In January 1870 the permanent curvature was so far annulled that in sitting on a flat chair it disappeared. Of course in standing (since in this posture the pelvis was necessarily oblique) curvature reappeared. An additional sole of cork was ordered ; he wished to avoid the appearance of a high shoe, and would only tolerate about a quarter of an inch, but even this diminished the curvature. Perhaps we must be content with such result. No surgical art can remedy the inequality in length of the two limbs ; but the spine was straight whenever the pelvis was not oblique—in other words, there was (April 1870) no morbid or permanent lateral curvature.

June 1872.—The limbs were, by the natural progress of growth, referred to at p. 72, very nearly equal in length ; the spine was straight ; and he has passed the army medical examination.

CASE VII.—Hon. Miss —, aged $13\frac{1}{2}$, was brought to me by her mother on account of projection of one hip, February 4th, 1888. For some months an awkwardness in her gait and in her sitting posture had been observed. On examination, I found a very marked curvature of the lumbar spine to the left, and a certain loss of the normal anterior curve. A narrow strip of lead laid on the loins between the 10th dorsal, and the upper part of the rima natium, showed that the second lumbar vertebra had deviated very nearly $\frac{1}{4}$ inch to the left. The rotation also was considerable.* The ilia were level or nearly so ; but she had the habit of standing chiefly on the right foot. As the girl was healthy and fairly strong, I conceived that she would bear somewhat energetic treatment.

Ordered one thickness of leather to be taken from the heel of the right, and one to be added to the heel of the left

* I was at this time devising my scoliosis gauge ; but the first constructed instrument was not altogether reliable. I therefore refrain giving the measure of rotation in the text. It seemed to be about 7° .

boots and shoes. The sloping seat to be used for $\frac{1}{2}$ hour three times a day. The lateral sling to be used in bed from her own retiring time till her mother or maid went to bed, and also in the morning from the time the servant got up till her own hour of rising. A loin bandage (p. 177).

February 29th.—Improved, but the loin stiff in the direction of left flexion. I instituted lumbar rachylisis, and prescribed the rachilytic exercise. In applying the former I forced, with all my weight, her body well over to the left. This was done once a fortnight.

April 2nd.—There is now considerable improvement. The strip of lead marks a deviation of $\frac{1}{3}$ of an inch, and the spine was very much more flexible, and yielded better to the lumbar bandage, which had therefore to be shortened.

June 2nd.—The patient has continued the fortnightly visits, and is greatly better. The leaden strip lay now on the right edge of the 2nd lumbar vertebra. My scoliosis gauge (now nearly perfect) marked a rotation of 4° .

September 4th.—Since end of June the patient has returned only once a month, and was at this date brought from the country. There was still some deviation and rotation, and the parts on the left of the lumbar spinous processes were still hard. The improvement less than in previous intervals, and I found the methods prescribed had been more laxly carried out. Rachylisis this time with pulleys, and a little lecture on the folly of supineness.

December 4th.—Very much better. She has grown a good deal, and the deviation very slight.

February 27th, 1889.—Really well; but recommended continued use both of the sloping seat and of the different height of shoes. To see me again in July, to guard against any relapse.

CHAPTER XI.

TREATMENT OF DORSAL CURVATURE.

DORSAL curvature, not arising from any thoracic disease, is to be treated on lines modified from those advocated for lumbar curve. But the modifications are considerable and of great, even of fundamental importance. Also, it must be observed, that the cases differ greatly in degree and in every conceivable point, save merely the existence of curve ; thus, in order to explain treatment, it is necessary to define the sort of case in which this or the other device is applicable. To give some idea of this great variety : the deformity may originate from one of several causes, may sometimes be chiefly marked by rotation, sometimes by lateral deviation ; it may have been of slow and insidious progress, or of rapid, almost sudden development, or it may have been coming on slowly for some time, and then quickly culminate in changes of startling celerity. The patient may be of robust, sturdy build, or long, slim and weakly ; the age may vary from that of an infant to that of a mature

woman, even of a mother with children seven or eight years old. The case may come under expert observation, when, as yet, such slight deformity exists that a practised eye only can detect it, or later when a marked and plainly visible protuberance may be seen, even through the clothing. Either may be in first, second, or third stage.

A slight curvature in a young person, which comes under skilled notice while in the first stage, is curable with little difficulty if sufficient attention be given. After measuring and recording the degree of rotation and lateral deviation (see p. 126), and after verifying the stage of deformity, the chief essential is to discover, if possible, the cause, and it need hardly be said that, whenever feasible, this must be removed or modified.

A permanent or habitual pelvic obliquity may be treated by the means already notified, for although the higher shoe and the sloping seat are more especially aimed at lumbar curve, yet their influence extends higher, and if a secondary lumbar curve have already formed, these devices will be very valuable. One must, however, be careful not to mistake for dorsal S-shaped curve, the not very uncommon simple curve to the left; also as to more severe cases, a note of caution must in the future be sounded.

Should one of the bad habits, described at p. 106,

be discovered, it must be corrected ; if it have been acquired at a flat table, a desk must be provided, and should the habit be that sketched in Fig. 15, and do not yield to the usual desk, it will almost certainly do so to the use of a narrow one, so that the left elbow reposes on the table at a lower level than the right, the left hand only, as far as the wrist, being on the desk, which should be not more than ten inches broad, with an angle of 15° . If the trick be that which I endeavoured to show in Fig. 16, in which the child stooping down and to the left, sits as though trying to look under the writing hand, he should have a higher table, or a desk which, when placed on the table, stands so that its lower edge is at the height of the xiphoid cartilage ; its angle should be 30° ; it should be deep from before back and he should never write at its lower part. This precept may be enforced by a low narrow ledge for the support of the paper about six inches from the lower edge. If the trick be carried very far and be inveterate, such desk may also slope sideways, *i.e.* be higher on the left side than on the right ; an incline of 10° , in that direction, is sufficient to render the position in question all but impossible.

A child who has learnt a bad position in writing must always be watched and must never be allowed to sit or place his paper askew on the table. If

these devices do not correct the evil habit, there should be screwed to the chair on which he sits to write, two arms or branches, which, projecting forward, come in contact with the sides of the chest a little below the axillæ, and the seat of such chair must be sufficiently narrow to prevent the possibility of sitting to one side of either branch.

In the intervals of work, exercise should be prescribed; to weakly girls, of course, less than to the more robust. It is impossible to lay down any general rules as to the amount. A good run, driving a hoop, battledore and shuttlecock, especially with the left hand, or lawn tennis, are all good methods of exercise. The sort to be most avoided are those monotonous walks, trailing two and two, to which so many school-girls in large towns are condemned.

A young patient, thus considerably employed in writing, should avoid other fatigue to the back in the sedentary position, and she should do her reading and learning by rote in recumbency. To study while lying flat on the back is very fatiguing to both eyes and head, nor is there any intrinsic remedial virtue in that posture. Repose of the spinal muscles is the object which may equally be gained in the supine position; thus I recommend such a patient to lie on the front of the body, and to have the book propped at a convenient angle

and distance for reading, while she rests the upper part of the body on the elbows. Some patients find that the rather sharp backward bend thus caused in the lumbar spine produces aching; this can be obviated by placing a cushion or rolled-up shawl under the abdomen, about the level of the umbilicus. Should rotation of the spine be pretty strongly marked, and therefore backward projection of the right shoulder, she should be directed to let that arm lie on the couch by her side, and to support the chin or forehead on the left hand, and this on the elbow, thus throwing back the left shoulder.

The above are, if taken alone, prophylactic rather than curative measures; but combined with the more potent remedies to be now discussed, they become remedial. In cases, that as yet are not severe, are marked by rotation rather than by lateral deviation,—especially if there be any reason to suppose that carrying weight on one arm may be the first cause of the curve,—certain exercises with the left arm are valuable. The first is this: The patient standing in drill posture lifts the left arm outward from her side to a right angle with the body, the palm looking downward. A weight of $\frac{1}{2}$ lb. to 2 lbs. is placed in her hand, she holds it in this position for five or ten seconds and then slowly raises her arm, still kept straight and outward from the side, till the hand is immediately over the

shoulder.* In raising the arm higher, that bone is turned on an antero-posterior angle, the movement being produced by the lower portion of the serratus, assisted by the anterior fibres of the trapezius; here it is kept a few seconds and then the weight is allowed slowly to descend through the same arc and still with the arm straight. The number of repetitions, like the amount of weight, must depend on the size and power of the patient. A second method is to sit on a stool or low-backed chair and with the right hand to take hold of a table or other firm piece of furniture, so that that hand lies in front of the left lower ribs. In the left hand is placed a dumb-bell, from $\frac{1}{4}$ lb. to 1 lb. in weight. The arm kept quite straight, and at a right angle to the body, is rapidly thrown from opposite the middle line in front, as near as possible to the corresponding point behind; in front, the back of the hand should look upward, behind downward, and throughout the patient's face is to be directed to the ceiling. Another way of exercising the left serratus, less exacting but more constant, is to fasten round the arm, about the insertion of the deltoid, a strap of lead about $\frac{1}{10}$

* It will be recollected that the deltoid can only lift the humerus till it lies in a straight line with the spine of the scapula.

inch thick, $\frac{1}{2}$ to $\frac{3}{4}$ broad and ten inches long, or less, according to the size of arm. It should be covered with thin mackintosh, to prevent lead absorption, and with silk ribbon long enough to go again round the arm and be tied. Some girls' arms are very cylindrical and show none of the usual constriction about the insertion of the deltoid ; in such cases the bracelet will slip down, unless one puts round it, not tight enough to impede circulation, a stationer's india-rubber ring. This device may appear, at first thought, very inoperative, but its constancy renders it much more potent than one would, without experience, conceive. I have cured many slight cases with it, and one or more of the already named devices, sloping seat or high shoe, as the case may indicate ; it is also exceedingly useful when the more potent means, to be mentioned immediately, have cured all but a certain rotation 2° or 4° , and these methods of treatment are being gradually relaxed, previous to their discontinuance.

Another means of relieving the one shoulder and throwing weight on the other, is that which I have named the shoulder-sling, and which is useful in moderately severe degrees of weight-bearing curve. The outline diagram represents it as in a case of right dorsal curve ; the triangular piece is made of very thin, highly tempered steel of a V-shape, with cross-pieces for strength. The upper side of

the triangle is made of a piece of strong webbing drawn through an india-rubber tube, padded, enclosed with wash-leather. The triangle is represented covered with some strong woven fabric. The left shoulder is enclosed in a loop of webbing from which run down, back and front, two webbing straps to the apex of the triangle. These straps are provided with buckles for regulation of tension and with strong india-rubber rings for elasticity. When first applied, this sling should only be used for three or four hours a day, as the edges of the axilla are somewhat sensitive to friction; they soon, however, get harder and the time of wearing may be increased: if the dress do not hold it in place, a piece of $\frac{3}{8}$ wide elastic passes from each angle round the chest. For girls, whose curvature has been caused by baby-carrying, the sling must support the left shoulder.



FIG. 31.
The Shoulder Sling.

When the patient ceases her lawn-tennis, her other exercises, or her allotted task of writing, she should

immediately lie down for half an hour or more. The supine position is very irksome to young active-minded people, as it is almost an absolute bar to all employment, nor is there any curative virtue in that posture ; the object of recumbency is simply relief of the dorsal muscles from the task of supporting the spine : thus lying on the side may be adopted, but a better mode is to lie on the face, in which position, if a book be propped against another at an angle with the floor, reading is easy and comfortable ; as, however, to lie thus supporting the head on the hands, while the elbows are on the couch, causes to some, such a bend in the loins as induces aching, a pillow should be placed under the abdomen at the level of the anterior iliac spine. To make the posture act powerfully as a rotary force the patient must be arranged thus. She lies prone, with the thighs and legs straight, letting, for greater comfort, the feet project over the end of the couch, under the lower part of the abdomen is a thin pillow ; the right arm (convex side) lies along her body, the left is brought up, the hand supporting the chin or forehead, the elbow resting on the couch, the left shoulder upholds the weight of the trunk being thus thrust back.

Mothers, who bring growing and somewhat feeble girls, constantly tell me that, in spite of all their rebukes, their daughters are always lolling, leaning

on their elbows, &c. This in the maternal point of view may be very naughty and inelegant ; but it is the means, which nature teaches the girls to adopt as rest for their tired muscles, and I always, in the absence of the patient, beg the mother to let her loll and recline, to lean her elbow on the table and to let her sit in the most unmitigated of easy chairs. One cause of boys being comparatively exempt from curvature, is parental indifference to their ungainly sprawling.*

The treatment of a greater degree of curvature may include cases in which the dorsal rotation amounts to 8° or more, irrespective of lateral deviation, which is, however, very nearly always present when that degree of twist exists. We may take the cases to be in the second, or in the earliest phase of the third stage. In the former, be it remembered, a certain shortening of ligaments has taken place on the convex side; in the latter, deforming changes of the bones is superadded. Here, before going further, I must point out that in such cases both the sloping seat and the heightened shoe may be unadvisable until by treatment the ligaments have

* Many of the devices of treatment, to be mentioned in the next few pages, are also applicable in the slighter cases just considered, such as the lateral sway. Some of the bandages, and those that may thus be used, will be pointed out as they are mentioned.

been somewhat relaxed ; because if those of the loins will not permit that portion of the spine to correct its curvature, when the pelvis is placed in an oblique position, the body will maintain its balance by increasing the morbid curve of the dorsum ; therefore, it is imprudent to prescribe these without previous observation of their effect ; nevertheless, patients in this far advanced condition are capable of being cured by elastic traction and enforced positions, as many of my previous cases show, but only after a considerable period. It takes a long time to stretch shortened ligaments by gradual process, and therefore for several years past I have been cautiously experimenting on and perfecting more potent methods of stretching the ligaments on the concave side, whereby I obtain much more rapid and certain results.

In quite the earlier part of the second stage, the patient may effect a good deal for herself, partly by the exercise shown in Fig. 30, which, however, only acts on the lumbar portion of the curve, chiefly by the following : In the ceiling of a sufficiently lofty room two hooks or staples, about eighteen inches apart, must be fixed ; from these hang down two strong cords, to the end of which rings of about three inches radius, made of iron or brass, about one inch in diameter ; they are to hang so that their lowest point is about level with the

erect patient's eyes. She stands evenly between them, and taking a ring in each hand sways her self to either side, and then by alternate traction with each hand swings her body in a circle, keeping the feet as nearly as she can on the same spot. The face, chest, &c., are always to look in the same



FIG. 32.—Ring Exercise for stretching Contracted Ligaments.

direction. If this be attended to, it does not matter whether the circle passed through by the head be traced from left to right or in the contrary direction. As seen in the diagram, the figure is bent in constantly different directions, the object being not to influence the spine by making it bend in a direction

contrary to the morbid curve ; but simply to loosen the tightened ligaments, now on the left, now on right, *i.e.* in the concavity of dorsal and lumbar curves alternately. The adoption of this exercise into the surgery of Lateral Curvature is, I believe due to Volkmann.

If the pelvis be amesial to the left (Fig. 17), some considerable assiduity will be required to overcome the condition ; but if such be used, it can in general be mastered within a few weeks. Three, or even four times a day, the patient must stand with her left side against a flat even wall, her hips and shoulders being at a right angle to it, and the outside of her left foot close to its base. The right foot at this period, will be a few inches away, as otherwise she cannot stand. But now the nurse or attendant standing behind her puts her right hand on the patient's right side, just below the axilla, and places between her left hip and the wall a block or book, from four to six inches in breadth, and the patient being supported by her attendant's hand, with the left shoulder close to the wall, is to shift the right foot into contact with the left. Few can support this position for more than four minutes ; repeated often enough its effect is rapid. Another means which, however, I less often employ, is to place a weight of six or eight pounds at a commensurate distance from the hook used for the

exercise (Fig. 30). On this is placed a pulley through which is passed a cord going to the loin strap. The patient stands with her left foot against the weight and gives the left hand to the attendant, who, pulling simultaneously on the hand and the cord, draws the upper part of the body to the left and the pelvis to the right. In this exercise some little force may be used.

The next few devices are directed especially against rotation. The respiratory exercise is performed thus: Into two walls opposite each other, and not too far apart, hooks or staples are driven and to each is attached a cord ending in an accumulator and cross handle. Midway between these staples the patient sits, in some cases on the sloping seat, and the handle attached on her right is put into her left hand passing behind her loins, while her right hand, passed in front of the body, grasps the handle attached to the staple on her left, the cords being of such length as to exert considerable traction on the arms. In this posture the patient is to take several deep, and slow breaths, the inspiration being longer than the expiration, and there should be, if possible, only four or five to the minute. If the posterior thoracic wall be watched during this exercise, the left will be seen to move backward very much more than the right side.

Slighter, but still valuable exercises, are these,

the patient seated on a stool, or in the suitable cases on the sloping seat, clasps her hands and places them, palm downwards, on the top of her head,

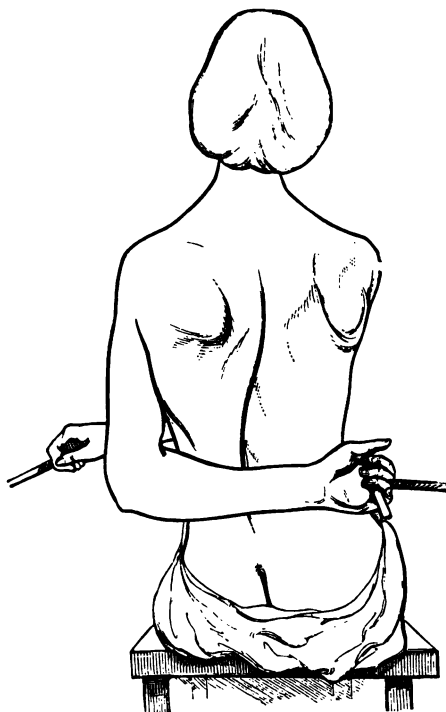


FIG. 33.—Left Respiratory Exercise.

grasping it a little behind the parietal protuberances, by spreading her thumbs ; the elbows being brought well back. By this means the head and

upper part of the trunk are, as it were, consolidated ; she is then to turn to the left, so as to see as far behind her as possible, taking care not to loosen her grasp on the head. A nurse or attendant can help a little by taking hold of the elbows and by gentle force turning her still a little further ; this aid is merely supplemental and is not to take the place of, the voluntary effort.

The patient is to acquire the habit of standing and walking very frequently, but not constantly, with the left arm crossed behind the waist-belt, so that the elbow is pretty close to the side, an inconspicuous and not inelegant position.

Very marked in its effect is that which I have named the lateral sling.

I used this for some years as a loop suspended by rope and pulley, above the patient's bed or couch ; afterwards I modified the method and it appears that, a little afterwards, both Professors Busch and Volkmann hit simultaneously on the same



FIG. 34.—Lateral Sling.

idea. The appliance, as I now use it, consists of four angle brackets, whose arms are ten and five inches long respectively; the shorter arm has three

screw holes in it; the longer has, close to the top, which is rounded, a larger hole; into this hole fits loosely the screw end of a round rod and to the screw is fitted a nut, the rod being shouldered for full grown people at six inches, for smaller folk at four. The short arms of the brackets are screwed to the long side of a common mahogany or beech board, fourteen long by six, or for children, by four inches broad. Tacked round each cross-piece is a piece of webbing, twenty-four inches long and either



FIG. 35.—Lateral Sling in Action.

six or four broad. In this sling the patient places the right posterior part of the chest, as she lays herself down on the side, a little turned on the back, so that the most protuberant part, the angles of the ribs, come into the most dependent part of the hammock, while the head is supported by a sufficiently bulky pillow. Of course there is no necessity for the nudity which the plate indicates,

merely to show more clearly the position. The patient should wear the usual night-dress. The sling is kept conveniently by the bedside and the nurse or maid on first rising puts it in position and the patient lies in it till getting-up time. On first going to bed it is again used, and may be removed, generally without waking the patient, in an hour or two. It is so little irksome that young people generally, both morning and evening, sleep in it quite comfortably.

RACHILYSIS.—Screwed to a door-post, or other firm bulkhead, are two strong hooks, the one a little more than three, the other seven feet from the floor; between these is one of those blind-cord fasteners, over which one turn of a line secures it immovably. The patient stands (the curve is right dorsal and left lumbar) with her right side towards these hooks and the horse-girth loop is placed upon her left loin, as already described. Over her left arm, up to the shoulder, is passed a sufficiently padded loop of such wide webbing, so that one part passes over the acromion, the other under the axilla; from the points where back and front these portions join, a second loop of webbing (about thirty-eight inches in all) runs, the one part over the back, the other over the chest. The middle of the loop plays freely in a loose knot in a strong flax cord, which runs through a little pulley hitched upon the

upper hook. The patient is thus arranged : having the girth on the left loin, the patient moves away from the bulkhead till the cord holding it is taut ; she then leans her body to the left, as far as she can ; the surgeon placing a hand on her left shoulder pushes her still a little more over and with his other hand draws the upper cord through the pulley, till it is taut, and secures it by a single turn round the blind-cord holder. All this occupies only a few seconds, a shorter time than it takes to read the description ; but it should be said that the patient should not be nude. A combination garment, vest, &c., also, if it be desired, the chemise, but no stays may be worn.

Now the surgeon goes to the left side of the patient and turning her a little, so that her front faces him a little more (the long webbing loop slides in the loose knot of the cord) he passes one arm in front, one behind her and clasps his hands over the projecting angles of the ribs and with considerable and increasing pressure, draws the most prominent part of the dorsal curve towards the left, while, at the same time (if he has caused her to face him sufficiently), he will untwist the vertebral rotation. The work is for the surgeon a little fatiguing, especially if he have to carry it out on several consecutive patients. The easiest method is, I find, to place his feet, one behind, one in front

of the patient's, and firstly, to simply hang the whole weight of his body through the medium of his clasped hands on the protuberant right chest of the patient. For slightly built and quite young people this will be enough, especially at a first sitting ; for stronger, more sturdy patients, he may increase the power by drawing himself up (bending the elbows and shoulders) and then letting his weight fall again with a somewhat sudden impulse on the patient's spine, which generally produces a little rapid expiration, with a sound like the exclamation "ugh!" The operation (if I may call it so) occupies one minute. I have never yet exceeded one minute and a half, and I use from ten to twenty of those jerks. After this is done, the patient in the same posture, the surgeon goes to behind her right scapula and putting one hand on the protruding angles of the right ribs, the other on the projecting bodies of the left ones (just below the mamma), he presses the right side of the thorax forward and the left backward, as far as his strength will allow, asking occasionally if pain be produced. All this work is rather fatiguing to the surgeon, nor can he, if the patient be full grown and rather strong, command as much power as may be advantageously employed. I have, therefore, for some time past, called to my aid the usual system of pulleys used for the reduction of dislocation. In

addition to the loin-girth and shoulder-loop, above described, another webbing brace is required, which



FIG. 36.—Rachilysis as employed for curvature dorsal to right lumbar to left. The pads on the left side of the loin and right side of the chest are for simplicity-sake omitted, and the struts keeping asunder the ends of the girth are not sufficiently plainly marked. The wood-cut shows how each of the curves is reversed by the sway of the figure to the left and by the action of the pulleys.

passes over the most prominent part of the dorsal curve properly protected by a pad. The ends lying

quite close to her left side, are kept apart by a strong strut of wood, so as to prevent the girth embracing the right ribs too closely and thus, perhaps, aiding in diminishing their angles, which thus arranged they cannot do. The loop of cordage at these ends is hitched to the one block of the pulleys, the other being secured to a cellar-flap ring, let into one of the beams which support the floor. Thus the force acts at a right angle to the dorsal curve, whose upper limb (returning towards the mid-line) is counter-stretched by the webbing loop while the lumbar curve is straightened by the loin-girth.

Patients bear, without pain, either at the time or afterwards, a great amount of force thus steadily applied; I have never seen any injurious, nor even unpleasant results. Frequently, immediately after using, one or the other mode of rachilysis, I have measured the spine and found a diminution of 2° to 3° in rotation and from 0.2 to 0.5 of an inch in lateral deviation. In one case, a girl aged sixteen, I found, after the first application, very nearly 4° less of rotation and 0.3 of lateral deviation; the curve was a severe one. Measurement, used immediately after rachilysis, is experimental. Moreover, that degree of change is only immediate and temporary; but to maintain as much advantage as possible, it is better to apply at once one or other of the bandages now to be described.

For several years past I have modified somewhat the form of bandages for dorsal curves. For such I now use one of two forms; the one is called a dorso-lumbar bandage, and is potent, more especially against lateral deviation. The



FIG. 37.—Back.



FIG. 38.—Front.

The Dorso-Lumbar Bandage.

lower part, leg and loin portions, are like the bandage shown in Fig. 29; the addition is a part carefully cut and fitted to the right side and passing over the shoulder; its form is seen in the annexed

figure ; the lower edge lies on a level of the seventh or eighth rib, according to the case ; the power is got from the lower front and back angles by means of webbing straps with intercalated strong india-rubber rings and provided with clasps and buckles. These, when fastened to the left side of the loin-piece, draw the convexity of the dorsal curve strongly over to the left, while the loin-piece itself pulls the lumbar curve in the contrary direction. The upper strap in the figure marked in lighter tone, which passes from back upper corner of the chest-piece under the left axilla to its front, is merely a piece of $\frac{5}{8}$ or 1 inch elastic, exercising no power on the curve, but intended merely to prevent that part of the appliance slipping off the shoulder.

The "rotation bandage" only differs from that just described by the disposition of the straps ; but it is thereby enabled to act in a very different manner. The strap from the lower back corner of the chest-piece, instead of running directly across to the loin-piece, as in the bandage last described, passes across the back, under the axilla, over the shoulder and returns higher up, across the back, to the back upper corner of the same piece ; if the lower corner be low enough, it gets as much bearing from the chest, below and about the axilla, as from the shoulder.

In putting on this bandage, it is essential, the leg and loin-piece being in place, to put the chest-piece well home and to get the line, between the attachment to it of the two straps, perpendicular ;

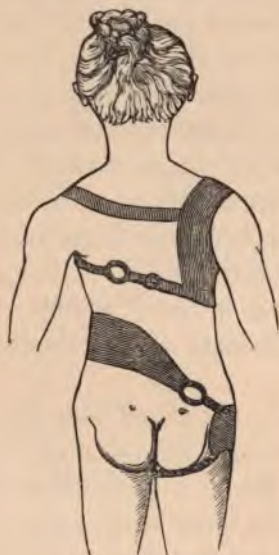


FIG. 39.—Back.



FIG. 40.—Front.

The Rotation Bandage.

then to fasten the rotation loop and lastly the strap, crossing the lower part of the chest. If the surgeon will watch his patient's figure, while he is fastening this last strap, he will see it turn considerably, right side forward, left backward.

One or other of these two bandages is to be chosen, according to the condition of the case ; in some instances, rotation largely predominates over lateral deviation, in others the latter is the more pronounced deformity. In the latter condition it is well to begin with the dorso-lumbar bandage. If rotation be equal to or more than the sideways bend, the last-described bandage should precede the other. It has, as well as the effect on the twist, considerable power on the deviation of the spine. Nevertheless, and although I can give no other reason than that of experience, more rapid progress is made, unless lateral deviation greatly predominate, if rotation be first attacked. Whenever it may be thought necessary to change the bandage, it may be done in a few minutes, by taking away all that part of the strap which goes to the left of the ring, save one or two inches, to which a clasp is sewn, as also one to the proper spot of the loin-piece. It then at once becomes a dorso-lumbar bandage.

These bandages are only to be worn during the day. The best garment for the patient to wear is the combination, and the bandage can be put on between that and the linen ; but if a little slit be made in the chemise, on a level with the right hip, out of which the leg-pad may pass, it can be worn outside that garment also.

These appliances, without causing injurious re-

straint, exert a good deal of power over a considerable surface ; but the important point is that being strongly elastic, the action is constant ; hence often, even when, immediately on application, no change in the form of the trunk is perceptible, yet if the patient return in a week or two, quite appreciable improvement will be observed. Of course, this is more rapid at the commencement of such treatment ; hence, when the bandage is first put on, it is desirable to see the patient again in from a week to ten days. Also sometimes, when deciding as to making any change in the tension or balance of the bandage, it may be desirable to put it on the nude trunk and watch for a few minutes its effect on the bare deformation—of course, better seen under such circumstances. If the case be sufficiently severe to require rachilysis, the bandage should be adjusted and balanced first on the patient's figure rather tightly. Then it is to be removed, rachilysis employed, and the bandage replaced as soon afterwards as possible : it will very likely require a little tightening again, as the rachilysis so greatly alters the figure.

CASE VIII.—Miss R., aged $17\frac{1}{2}$ years, was sent to me by my late friend Dr. Cotton, October 12th, 1867, on account of the following conditions : During the last three or four months, she having lost health, flesh, colour, and appetite, was taken to see Dr. Cotton, who found no signs of tubercle in the lung, but simply failure of vital power, he also saw upon

her one of the usual steel supports that had been ordered her by one of that persuasion, and made by a practised maker. On questioning her, the physician found that five months ago some apprehension had been excited by tendency to stoop, and she was taken to Mr. —, who, ordering the usual mechanism, had seen her frequently, to screw up the levers in the interval.

In my presence the scaffolding was removed, and I found a dorsal curvature to the right, not severe, plainly marked ; with those particular additions which I have always observed with backs that have for a length of time been supported by stiff instruments—namely, that on first removal the spine remains in the same attitude, with a certain rigidity ; rotation being more marked than the lateral bend. After a time, and generally on a sudden, the back gives way and sinks into very considerable curves, and then the spine becomes again more flexible. There is considerable tenderness of the spinal muscles.

The patient is suffering under a morbid irritability ; she flushes very easily, and has fainted once or twice on very slight occasions. I therefore ordered no exertion by position or exercise, but simply that she should remain erect but very little at a time, until a less exacting mode of support could be made.

25th.—The bandage was applied on the 18th, and she has since sat up more, and walked about a little, she is better generally ; irritability is much less ; the pain and tenderness of the spinal muscles have disappeared, or nearly so.

November 20th.—The back has improved each time that I have seen it (about every ten or twelve days), and now the condition is very much better ; her morbid irritability is gone, and although closely watching, I have seen none of the old transient flush. The tenderness of the spinal muscles has also quite disappeared. The sloping seat, rising $1\frac{1}{2}$ inch to the foot, is ordered for her, which she is to use ten minutes twice in the day.

December 18th.—Still improving.

January 23rd, 1868.—During the last few weeks this young lady's improvement has been very rapid. There is now but very little lateral deviation; the rotation, however, is to a skilled examination very evident.

March 2nd.—This case is to be considered well. The patient's back is perfectly straight; she has gained health and flesh, her spirits are good, and she can take a fair amount of exercise.

April 17th.—I saw this patient again; the back remains perfectly straight.

CASE IX.—Miss F., aged 24, came to me, 12th April, 1869, with a well-marked dorsal curve to the right. She is tall and slender in build, and is thin; the limbs are not weak, but she has worn an iron instrument, with crutch handles, for two years and six months, and the muscles of the back are shrunk. A fortnight ago some of the steel broke, and, during its repair, both she and her friends were alarmed to see how little she could sit up; how her power of walking even a little way had diminished. The instrument was therefore not re-applied, but the young lady was brought to me.

I found the back excessively feeble, so that it could with difficulty support the trunk. The muscles on each side are shrunk, so that the spinous processes project. The back, besides being weak, was very stiff; I consider this rather the effect of the treatment than of the disease. When told to sit quite upright for a time, and the back was watched, it could be seen to remain in good position for a minute or two, then it suddenly gave way, and the spine sank into more severe curves.

An oblique bandage, with a larger pectoral pad than usual for this patient was ordered. Until the bandage was made she was to remain a good deal recumbent, and under all circumstances to lie down as soon as the back became fatigued. After a week the bandage was applied.

May 12th.—The difficulty of this case was not with the disease itself; the excessively weakened back barely permitted further management than the mild non-restraining support, and avoidance of fatigue. This debility by this date had a little decreased.

June.—There was now more evident return of strength, and the health has improved.

July.—Considerable improvement in strength, and the back was straighter. She was now permitted to use the sloping seat a few minutes at a time.

October.—The case has greatly advanced towards recovery. The back is now fairly strong; she walks a mile at a time without difficulty, and has walked two, but with fatigue. The same ordinances, with the addition of allowing her to ride on the wrong side of a steady old horse, and at a walk.

The rest of the case is not worth following minutely. The patient at the end of March, 1870, was considered well, but asked still to wear the support. I saw her again in May of the same year, and the bandage was discarded. She is quite well in health, the back being perfectly straight. She has become sufficiently *embonpoint*, and is a very pretty figure.

CASE X.—Marion S., aged $9\frac{1}{2}$ years, was brought to me April 6th, 1880. Some defect and awkwardness having been observed by her dancing mistress seven months previously. The child has been growing very considerably.

She had a strongly marked dorsal curvature to the right, with a rather advanced secondary lumbar curve in the contrary direction. She was tall for her age; rather anæmic and weak; her limbs were well formed; there was no bending of the ribs, nor any other sign of rickets; the lungs were sound, though she easily got out of breath.

I ordered the lateral sling to be used at night, and, for as long as could be managed in the morning, a dorso-lumbar bandage; and that all lessons requiring writing should be restricted as much as possible; others to be done in the

prone position with a pillow under the abdomen. Iron internally.

June 4th.—She has now worn the bandage, and carried out the other recommendations for $7\frac{1}{2}$ weeks, and the back is certainly better, chiefly as to lateral deviation; the rotation is less affected. She was ordered to go on in the same way, but, as she is also stronger, use of the sloping seat was promised at a near future; also some modification in the direction of the force exercised by the bandage. Observation of certain cases had impressed upon me the idea that a form of appliance more directly counteracting rotation must be devised.

July 3rd.—Adopted "rotation bandage" by a slight change in straps (see p. 211). She is to use the sloping seat.

August 1st.—The rotation bandage has acted excellently. Continue in same way.

October 4th.—Child very much better. The right shoulder much less prominent.

February 1st, 1881.—Greatly improved, more especially as to rotation; but it appeared to me that in future it would be better to begin by acting against this part of the deformity, and to use the dorso-lumbar belt afterwards against lateral deviation.

It would be tedious to follow in detail this case further. I saw her last after a long interval. I had ceased to treat the case actively at end of 1885, only seeing her occasionally to guard against relapse. In May, 1888, she was nearly but not quite straight. At that date I had perfected my scoliosis gauge. The patient was between 17 and 18 years old. While dressed she looked not at all deformed; but the bared back exhibited to careful examination slight asymmetry. The gauge showed at level 8th dorsal vertebra $1\frac{1}{2}^{\circ}$ rotation, and 0·1 right lateral deviation; at level of 2nd lumbar vertebra 0° rotation. The spot made by the marking wire fell on the spinous process of that vertebra, but possibly not quite in its middle.

I will now pass over an interval of three years, during which I was perfecting my scoliosis gauge, and cautiously trying at first by merely manual pressure (p. 206) the principle of rachylisis. The earlier cases measured by the one and treated by the other device may be passed over. In employing the latter my motive was to accelerate the somewhat tardy effects of all devices hitherto used. I shall not be obliged, in the next few cases, to enter into any other than a general description of the patients' build and constitution. The condition of back can best be gathered by reading the diaries of mensuration. Some of these cases are quite recent, as yet incomplete.

CASE XI.—Katherine L., aged 13½, was first observed to be crooked four years previous to consulting me, October 7th, 1887. She had been treated by two practitioners, the one using exercises, the other orthopædic supports. According to her mother's statement her back is now worse than it has yet been. She was a rather short, somewhat sturdy girl, looking in her clothes short from waist to shoulder in proportion to the length from waist downward. I removed a heavy instrument. After letting her repose for a time, measured the deviations.*

At 8th dorsal vertebra : Rotation, 9°, lateral deviation, 0·9
 „ 2nd lumbar „ „ 4° „ „ 0·5

* My instrument of that date was not quite identical with the present one. Its indications, though fairly reliable, were not quite so accurate.

220 *LATERAL CURVATURE OF THE SPINE.*

Used Rachilysis, with loin girth and shoulder loop, by placing my hand on prominence of right ribs, and pressing them forward and to the left. Ordered rotation bandage and lateral sling.

November 21st.—Rachilysis has now been used five times.

At 8th dorsal vertebra : rotation, 7° , lateral deviation, $0\cdot3$
 „ 2nd lumbar „ „ 3° „ „ $0\cdot4^*$

January 6th, 1888.—Rachilysis, by manual force, used in all nine times.

At 8th dorsal vertebra : rotation, 6° , lateral deviation, $0\cdot25$
 „ 2nd lumbar „ „ 2° „ „ $0\cdot3$

Although improving, I was disappointed with the slowness, and I had made the arrangements for adapting pulleys, which were at this date used for the first time, in two periods of strong tracture, 3 and 2 minutes respectively.

March 1st.—The pulley mode of rachilysis has been used six times, the spine was very much more flexible.

At 8th dorsal vertebra : rotation, 3° , lateral deviation, $0\cdot2$
 „ 2nd lumbar „ „ 1° „ „ $0\cdot1$

May 31st.—Rachilysis has been used eight times since the previous report. The child has grown a good deal, and has a less thick sturdy appearance.

At 8th dorsal vertebra : rotation, 0° , lateral deviation, $0\cdot15$
 „ 2nd lumbar „ „ 0° „ „ $0\cdot0$

Alteration of bandage to dorso-lumbar.

July 2nd.—The scoliosis gauge indicated no rotation either in the lumbar or dorsal region, a small lateral deviation about 6th vertebra not amounting to $\frac{1}{4}$ of the decimal mark. She was told to continue the bandage till the end of August,

* These measures were taken with the perfected scoliosis gauge.

by which time it will be worn out. The lateral sling is to be used till the end of October, when she is to see me again.

November 6th.—Katherine L. is now a sufficiently tall girl, well formed, without any trace of crookedness.

I could give a number of cases of about the same date, so similar in history and result, that it is hardly desirable to fatigue the reader with them. I am bound, however, to say that one proved more recalcitrant, and, though she came to me in July, 1888, she is still considerably deformed, partly, I conceive, because for many reasons rachylisis was less frequently used, partly because there is a suspicion of certain bad habits unnecessary to specify. Another case, K. M., aged 14, coming a little later in that year, has also somewhat disappointed me. The case is of rickety origin, and is a writer's scoliosis. Although very markedly improved, the progress is slower than in all my other cases. I will now rapidly give the record of certain even more recent cases still under treatment, with the object of showing how powerful rachylisis is. Little besides the dates of measurement need be quoted.

CASE XII.—Miss. M., the lady mentioned at p. 85. In January 1889 :

At 7th dorsal vertebra : rotation, 15° , lateral deviation, 1·2

„ 2nd lumbar „ „ 7° „ „ 0·6

February 4th :—

At 7th dorsal vertebra : rotation, 9° , lateral deviation, 0·8

„ 2nd lumbar „ „ 5° „ „ 0·4

222 LATERAL CURVATURE OF THE SPINE.

March 5th :—

At 7th dorsal vertebra : rotation, 3° , lateral deviation, 0·6
 „ 2nd lumbar „ „ 4° „ „ 0·4

April 2nd :—

At 7th dorsal vertebra : rotation, 2° , lateral deviation, 0·3
 „ 2nd lumbar „ „ 4° „ „ 0·4

At this time I changed the bandage, as more power is required at the loin, less at the lumbar region. She has not visited me since. This patient suffered a good deal in February and March from continuous aching of the back. Rachilysis always checked this for the next few days.

CASE XIII.—Miss R. C. brought to me 14th January, 1889. The following notes were given to me by Mrs. C.—“The child is the elder of twins, the other being strong and well grown. They were born a month prematurely in July, 1876, and R. was throughout the winter at the point of death. In 1878 it was observed that she could not put the right heel to the ground (equinus). The foot was treated by stretching in a Scarpa's shoe, then by wire boots and double irons. In 1883 she suddenly failed, and was again dangerously ill ; had an inflamed and painful abscess on the foot. In March, 1884, took her to —, who said she had a slight curvature of the spine, but would ‘grow out of it.’ The irons, &c., were ordered to be discontinued, the sole of the right boot to be slightly thickened ; to have complete freedom of body. In six months, finding her back rather worse, took her to the same gentleman, who told me the spinal curvature was of no consequence, and ‘that everybody was or ought to be a little crooked.’ She was taken back twice again, the last time in January, 1887, with like results, and always getting more crooked. After this she went through a course of massage and douches ; then for more than a year wore a ‘spinal support’ ; then had a long course of daily Ling-

Swedish gymnastics. All this time she was getting worse, but, especially during the gymnastics in the last year, she has become much more crooked."

The case is one of severe S-curve; the child is left-handed, of peculiar and difficult temper, and takes no pains to carry out instructions unless closely watched; she is fairly strong; the pelvis is greatly amesial to the left. I arranged for using rachylisis twice a week; ordered a high shoe to the right foot, that limb being short. Lateral wedge exercise and lateral sling.

January 14th.—Rotation right dorsal, 15° ; lateral deviation, $1^{\circ}4$.

February 12th.—Rotation right dorsal, 11° ; lateral deviation, $1^{\circ}0$.

March 12th.—Rotation right dorsal, 8° ; lateral deviation, $0^{\circ}8$.

April 13th.—Rotation right dorsal, 7° ; lateral deviation, $0^{\circ}7$.

May 9th.—Rotation right dorsal, 5° ; lateral deviation, $0^{\circ}4$.

CASE XIV.—M. P., nearly 14 years old. I was consulted about her in December, 1888, having to write a report for her absent parents. She is short, strongly built, but the back was very crooked. At the above date I measured the dorsal distortion only, having first removed an orthopædic iron.

December 19th.—At 7th dorsal vertebra: rotation, 14° , lateral deviation, $1^{\circ}25$.

It was long before arrangements could be made for her to stay in town. During that period she went on wearing the iron, and the maker, who saw her two days before she left the country, said he was "astonished at her improvement."

April 4th.—Immediately after she came to reside in town. At 7th dorsal vertebra: rotation, 16° , lateral deviation, $1^{\circ}25$.

224 LATERAL CURVATURE OF THE SPINE.

Irons discarded. A rotation belt and a lateral swing ordered. Rachilysis applied.

April 12th :	Rotation,	9°	lateral deviation,	1·125	
„ 29th :	„	6½°	„	„	0·9
May 8th :	„	5°	„	„	0·6

Still under treatment.

CASE XV.—January 15th, 1889. Margaret R., aged 15, on whose case I was consulted last March by Dr. Steele, of Ealing, for whom I had ordered a rotation bandage and sloping seat. She was growing rapidly. Seeing her about every two or three months, and finding little improvement, had long wished to use rachilysis; but she lived in the North of England. Many difficulties were in the way, but at end of 1888 these were got over, and on above date I began that powerful treatment with the understanding that it should be done fortnightly.

In this case the pelvis was markedly amesial, and the lateral pressure exercise which was at the same time ordered had much to do with the favourable result. The measurements at different intervals of time are as follows :—

January 15th.—At 7th dorsal vertebra : rotation, 7°, lateral deviation, 1·1.

February 23rd.—At 7th dorsal vertebra : rotation, 5°, lateral deviation, 0·8.

April 6th.—At 7th dorsal vertebra : rotation, 2°, lateral deviation, 0·3.

April 25th.—At 7th dorsal vertebra : rotation, 1°, lateral deviation, 0·1.

The above is, except certain young children, the most rapid of my cases. Such result is due to the active treatment being carried on during a period of rapid growth, and to her assiduity in correcting the amesial condition of the pelvis. Of infantile

cases I select from my note-book the following: The first is the most severe curve I have ever seen in so young a child; the second is one out of three which are almost identical.

CASE XVI.—Margaret S., aged 5, a wiry child, with probably tuberculous or strumous tendency, sent to me by Dr. —, of Boston, December 12th, 1888. Has the most marked curve I ever saw in a young child. Her mother is sure that it was not congenital; indeed, it was only discovered on the 7th. The child has always been well, except a mild attack of scarlatina, nor has she received any injury. At 8th vertebra the rotation was 13° , lateral deviation, 0.9 ; the pelvis $\frac{1}{8}$ inch high on right; amesial to left. Ordered a heightened shoe on left; lateral sling and lateral wedge; rotation bandage. I feared to use pulleys to so young a child, but, sitting down, gripped her pelvis between my knees, and, placing my right hand on the dorsal protuberance, I bent her body over to the left, thus reversing the lumbar curve, while, with my left hand at her left axilla, I forced the upper limb of the curve to the right. I used all my power in doing this, and also, by pressing forward with my right hand, counteracting rotation. By these means the spine was at first rendered more flexible; afterwards I could absolutely reverse to a slight degree the curve. The great difficulty has been the backward projection of the right ribs, which now appears to depend rather on that change in the first part of those bones, and in the backward position of the transverse process than on rotation of vertebræ. The mensuration diary is thus:—

December 12th, 1888.—At 7th dorsal vertebra: rotation, 13° , lateral deviation, 0.9 .

January 4th, 1889.—At 7th dorsal vertebra: rotation, 12° , lateral deviation, 0.7 .*

* Lateral swing now ready.

February 8th.—At 7th dorsal vertebra : rotation, 9° , lateral deviation, 0.6.

March 14th.—At 7th dorsal vertebra : rotation, 8° , lateral deviation, 0.4.

April 17th.—At 7th dorsal vertebra : rotation, 5° , lateral deviation, 0.3.

I now began to use pulleys, the child making no complaint.

May 3rd.—At 7th dorsal vertebra : rotation, 3° , lateral deviation, 0.2.

CASE XVII.—V. G., aged nearly 6, sent to me by Mr. Thorne, December 5th, 1888. Thin, but healthy clear-complexioned child. Has been for some time suspected by her nurse of being crooked. She has been growing very fast in 1887, viz., $3\frac{1}{2}$ inches ; up to date in 1888, 3 inches. Right ilium nearly $\frac{1}{2}$ inch higher than left. Amesial pelvis, 0.6 inch. Spine very flexible, affected with S-curve. Ordered heightened shoe, rotation bandage and lateral pressure. Manual rachilysis as in last case.

December 5th.—At 7th dorsal vertebra : rotation, 5° , lateral deviation, 0.5.

January 8th, 1889.—At 7th dorsal vertebra : rotation, 3° , lateral deviation, 0.4.

April 16th.—At 7th dorsal vertebra : rotation, $1\frac{1}{2}^{\circ}$, lateral deviation, 0.2.

May 2nd.—At 7th dorsal vertebra : rotation, 0° , lateral deviation, 0.1.

CHAPTER XII.

MANAGEMENT OF EXAGGERATED CURVATURE IN
OLDER PATIENTS.

It was said (see p. 62) that women, having in their youth suffered from curvature, may, after certain occurrences, relapse—others who have never been strong, and whose spine has always been a trouble, are very apt to become feeble and very suffering and dependent on others. Their spines frequently become so crooked, that all the upper part of the figure overhangs the right ilium, being quite out of the perpendicular, and the lower ribs lie in the iliac fossa. Some of these ladies still wear what is called a spinal support, though, as they are usually thin, their bones near the surface, and the skin tender, they cannot bear any constriction over them; thus the machines are usually simply carried about hanging on the straps which pass over the shoulders. In other cases that I have seen, poro-plastic jackets have been moulded to them while they have been suspended, and these they are directed to put on, or rather to have put on during self-suspension. But in point of fact the material has not strength enough to

support the trunk hanging over, as above described, it gives way and simply takes the shape of the deformed figure, while the exertion of self-suspension tells too much on the enfeebled system of such patients.

In fact, these patients require very gentle and careful management. Hope of more than very slight improvement in form cannot be held out, but still further deterioration may be prevented, and their lives may be made happier and more comfortable. Firstly, all available means should be adopted to spare their strength, exertion such as going up and downstairs as much as possible avoided ; a little—in the weakest cases very little—walking on level ground may be permitted. Exercise should be taken when means permit in a well-hung easy carriage, provided with cushions, &c., in which she may lean comfortably back. Easy well-padded chairs, couches in her drawing-room, a wire spring-bed and comfortable chairs in the bedroom.

Many of these find the lateral sling very comfortable for a quarter of an hour or twenty minutes—a soft eider-down cushion made to proper size, about twenty inches long by seven broad, enables them to bear the pressure better. The neuralgic pains in the intercostals and also in the branches, of the last dorsal nerve, are best combated by

stimulating liniments containing a little atropine. Cocaine also relieves some patients ; but others find little or no benefit from it. They nearly always occur in their most painful form, after too great exertion, when complete rest is the best remedy. But, as already said, these cases are apt to get worse, the continual drag of the body's weight towards the right side constantly tends to increase the curve, and this tendency must be counteracted, by a force which not only upholds this sideways impulse, but even pulls the trunk in the opposite direction. The patient cannot bear without pain, or at the least without considerable discomfort, anything rigid, nor anything which makes pressure on a small part of the surface ; what pressure has to be made must fall on a considerable space, so that being thus widely diffused it may be, as a whole, considerable, and yet at any one locality slight enough to be not merely bearable, but comfortable.

The bandage shown in the next figure carries out these principles, and I have found it to relieve suffering, to permit of the patient going about much more easily, and after a certain time to improve the form, to a certain, but quite perceptible degree. Inmates of the Cripples' Home with this sort of curve, for sometimes even young women are in that class of life often thus deformed, find these bandages of great use ; those who had considerable

difficulty in getting about, previously to wearing them, become much more capable of moving with considerable freedom. They are thus constructed : The strap round the upper part of the thigh is arranged in the same way as in the other bandages



FIG. 41.—Back.

FIG. 42.—Front.

The Lateral Upholder.

described ; but the pad that lies over the ilium should be somewhat longer and slightly different in shape, it should be irregularly trapezoid and long enough from below upward to reach from the middle of the great trochanter to the crest of the

ilium, and its upper edge should be fashioned on the shape of that part. The shoulder and chest-piece is attached directly to this iliac pad, without the intervention of a separate loin-piece, for it is the lower part of the dorsal spine which chiefly requires to be drawn over towards the left side, therefore the pattern must be cut so as to enclose the back, lateral part and a small portion of the front of the thorax, as shown in the figure. It is no easy thing to shape properly a pattern which will be comfortable and at the same time efficacious, and no description will, I fear, help much, only practice will avail, to enable a surgeon to succeed. After the bandage has been cut to the pattern, it must be tried on and all its bearings and its action examined. It will be seen from Figs. 41 and 42 that to back and front lower corner, straps with clasps, buckles and india-rubber ring, are attached, and it is by means of these that the requisite traction is kept constantly active. In some cases, I have attached to the thoracic part a second strap higher up, and then the two run in loop fashion through the ring and maintain their own balance. The strap marked in lighter colour, passing from the upper back angle to front part of the arm-hole, is merely an elastic band introduced to prevent possibility of slipping.

By this method of treatment, patients whose

deformity cannot be cured are rendered as comfortable as possible ; some, even elderly ones, may be improved, and I have known improvement in younger badly deformed persons to be much more than I should *à priori* expect.

INDEX.

A.

	PAGE
ACTION of spine	I
Adams' physiological curve	19
„ statistics of sex	34
Age, Eulenburg's statistics of	35
Amenorrhœa as cause	86
Amesial pelvis	81, 113
„ „ measuring	125
Angles of ribs, changes in	55
Angular curvature differs from lateral	30
Antero-posterior curves of spine	6
Arches, changes in	48
Arms, position on trunk	149
„ sessile and pedunculated	146
Arm, weight for	193
Articular process, immature	3
Asymmetrical vertebræ and physiological curve	95

B.

BANDAGE, dorso-lumbar	210
„ rotation	211
Bandages, Lorenz	164
Band, elastic, for lumbar curve	177
Bell, Sir Charles, respiratory action of serratus	16

	PAGE
Bones, changes in the	45
Bouvier on physiological curve	90

C.

CARRYING babies, effects of	115
Causes of dorsal curve	87
" lumbar curve	71
Centrum pulposum, displacement of	44
Cervical secondary curve	152
Changes in form of vertebræ	46
Child-bearing, effect of	67
Commencement, three periods of	99
Congenital curvature	31
Convex side at loins	136
Corset, poro-plastic	162

D.

DEFINITIONS	30
Deviation, lateral	32
" " measuring	124
Diagnosis of dorsal curve	141
" of lumbar curve	129
Direction, Tamplin's statistics of	35
Discs, intervertebral	4
Displacement of viscera	57
Dorsal curve, causes of	87
" " treatment of	188
Dorso-lumbar bandage	210
Drück-verband (Lorenz)	165
Duchenne on respiratory action of serratus	18

E.

EPIPHYSAL plates	2
Eulenburg's statistics of age	35

	PAGE
Exaggerated curvature	227
Examine, how to	131
Exercise for shoulder	192
„ respiratory	201
„ with rings	199
Experiments, Hirschfeld's	5
„ on rotation by ligaments (Meyer)	26

F.

FLEXION of trunk	7
Forms, different, of curve	154

G.

GAUGE in dorsal curvature	152
„ in lumbar „	139
„ Scoliosis (author's)	118
Gürtelverband (Lorenz)	165

H.

HABITUAL pelvic obliquity	77
Heart, displacement of	58
Heinecke's pendulum for measuring	118
Heredity, question of	67
High shoulder	142
Hip, projection of	133
Hirschfeld's experiments	5
Hump of lateral curvature	152

I.

IMMATURE spine	I
Infantile curves	100
Intervertebral discs	4

J.

	PAGE
JACKET, plaster of Paris	163
„ poro-plastic	162

L.

LAMINÆ, changes in	48
Lateral flexibility of trunk	9
Lateral sling	203
Ligamenta subflava	5
Ligaments, intervertebral	4
„ rotating power of	25
„ shortening of	43
Ling-Swedish gymnastics	168
Loin bandage	177
Loins hard on convex side	136
Lolling on elbows	197
Lorenz bandages	164
Lumbar curve, causes of	71
„ „ diagnosis of	129
„ „ right	137
„ „ treatment of	169
Lung disease cause of dorsal curve	116
Lying on back	191

M.

MANUAL straightening of infantile spine	171
Marriage, question of	69
Mechanism, muscular, of rotation	34
Menstruation in causation	86
Methodical redressement (Lorenz)	116
Meyer on Hirschfeld's experiments	5
„ on rotating power of ligaments	26
Mobility in different parts of spine	28
Movements of spine	7
Muscular shortening	42

N.

	PAGE
Neck, enlargement at root of	153
Normal curves, antero-posterior	6
" " loss of, in scoliosis	40
Nursing on left arm as cause	99

O.

OBLIQUITY of pelvis	72
Orthopædic support, faults of	158
Outlines side, diagnosis by	135
Ovaralgia as cause of lumbar curve	86

P.

PEDICLES, changes in	48
Pelvic obliquity, habitual	77
" " permanent	72
" " to measure	124
Pelvis, amesial	81, 113
" " to measure	125
" to detect obliquity of	135
Physiological curve, Adams, Volkmann	91
" " Bouvier	90
" " Sabatier	88
Physiology of spine	1
Planes of back	39
Plaster of Paris jacket	163
Plates, epiphysal	2
Pleurisy as cause	117
Poro-plastic jacket	162
Posture, first stage merely a	41
Processes, articular, immature	3
" tips of spinous, in straight line	38
Prognosis	60

	PAGE
Prone position, value of	196
Pulleys to straighten spine with	208

R.

RACHILYSIS for dorsal curvature	205
" " lumbar curvature	179
Rapidity of some cases	60
Redressement, methodical (Lorenz)	166
Relapse, causes of	62
Renal disease, a cause of lumbar curve	85
Respiratory exercise	199
Rest, value of	191
Ribs, changes in	52
Rickets, influence of	67, 101
Right lumbar curve	137
Ring exercise	199
Rotation and spiral form	37
" bandage	211
" measuring in degrees	126

S.

SABATIER, physiological curve	88
Sayre's plaster of Paris jacket	132
Scapula, changed position of	143
" relative height of, measuring	127
Schenk's statistics of writing postures	104
Scoliosis gauge, author's	118
Seitenzugverband (Lorenz)	165
Self-suspension	163
Serratus, exercise for	192
" magnus as rotation	15, 24
Sex, Adams' statistics of	34
Shoe, high on one side	174

INDEX.

230

	PAGE
Shortening of ligaments	43
„ „ muscles	42
Shoulder, exercise for	102
Shoulder, high	142
Shoulder-sling	105
Shulthess' instrument for drawing	120
Side bandage	228
„ outline, diagnosis by	133, 147
Skeleton, scoliotic	53
Sling, lateral	203
Sloping seat	172
Slowness of certain cases	62
Spinous processes, changes of	49
Stage, first	41
„ second	42
„ third	45
Static curve	82
Straightening infantile spine	171
Supine position	191
Support, orthopædic, inutility of	158
Surface of back in diagnosis	134
Swedish gymnastics	168

T.

TAMPLIN, statistics of direction	35
Thorax, changes in	54
Transposition of viscera	96
Transverse processes, changes in	49
Treatment of dorsal curve	188
„ „ lumbar „	169
„ prevalent forms of	157

U.

UNDULATORY movements of spine	11
---------------------------------------	----

V.

	PAGE
VISCERA, displacement of	57
„ transposition of	96
Volkman on writing curves	105
„ „ physiological curve	91

W.

WEDGE-SHAPED vertebræ	46
Weight-bearing curves	115
Writing, faulty positions in	83
„ malpostures, to correct	190
„ postures, Schenk's statistics of	104

Z.

ZANDER Institute	168
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